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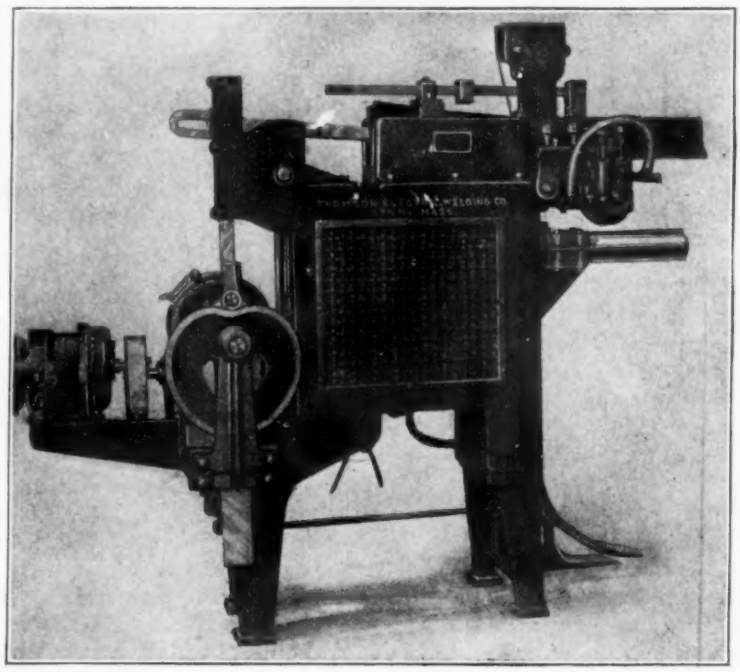


Electric Seam Welding

By P. T. VAN BIBBER

Sales Engineer Thomson Electric Welding Co., Lynn, Mass.

Outside of the manufacturing concerns employing electric seam welding machines, few mechanics realize their importance or method of operation. The machines and applications here shown will clearly indicate the field that is covered.

SEAM welding is the process of joining two overlapping edges of sheet metal for their entire length without the application of any solder or spelter along the joint. In the Thomson process of lap-seam welding, the heat is produced by passing a large volume of electric current through the edges to be welded by means of a copper roller on one side of the joint and a copper track or horn underneath. In any electrical path, wherever high resistance is interposed, heating will result, and the higher the resistance to the current, the greater will be the heating effect. In the electric lap seam welding machines, the copper roller and horn are good conductors and the joint between the edges of the metal to be welded is the point of highest resistance. On this account it is evident that the greatest heating effect will be at that point. As the roller passes over the joint, heating the stock to a plastic state beneath it, pressure is applied by springs on the roller which forces the two edges together as fast as they are heated. Since 20 B. & S. gage or lighter metal heats very rapidly, the pressure and heating can be effected at the same instant of contact by the roller, and it is possible to weld as fast as 6 in. per second.

The only preparation necessary for seam welding is that the stock must be absolutely clean, that is, free from any traces of rust, scale, grease, or dirt, if a tight, well-appearing joint is desired. If it is not necessary for the joint to be tight, it will not be necessary to have the stock so clean, although heavy scale or rust will obstruct the passage of current, so that little or no heating effect can be secured under these conditions.

In welding sheet brass of 22 to 30 B. & S. gage, to secure a perfect joint the metal should be carefully pickled and washed to remove all traces of grease and tarnish which tend to prevent the passage of current across the joint of the edges. The metal should be welded soon after pickling, as, no matter how carefully it may be washed, oxidation is always sure to start very shortly after the brass has been removed from the pickling acid.

Steel, to be successfully seam welded, should not have a carbon content of over 0.15 per cent., for a higher carbon steel than this has a tendency to crystallize at the point of weld, due to the rapid cooling of the welded portion from the surrounding cold metal. After welding, the joint will be found to be about one-third thicker than the single thickness of the metal. It is possible, by applying more pressure, to reduce this finished thick-

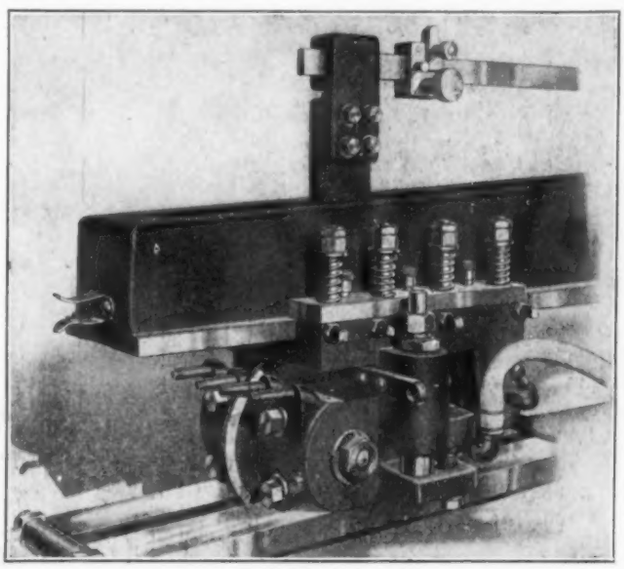


FIG. 2. DETAILS OF WELDING ROLLER HEAD

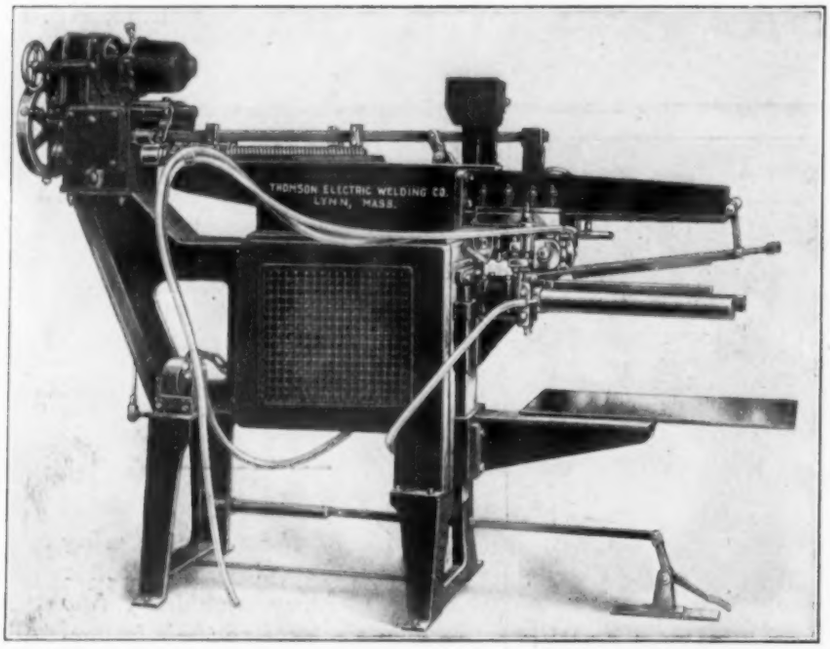


FIG. 3. THOMSON NO. 318 LAP SEAM WELDING MACHINE

ness still more, but it wears more on the copper roller to do so.

In welding brass, a soft, annealed metal should be used, for although hard-rolled brass can be welded, it does not force the two edges together very much and the finished joint under these conditions is almost twice the original metal thickness. However, with a soft, annealed brass the finished joint will be not over a third greater than the single metal thickness, and by applying sufficient pressure can be reduced down to be not over 10 per cent. thicker.

The principal advantage of electric seam welding is that no spelter and no flux are required, the metal itself forming its own cohesive properties, which allows great speed in production. The greatest efficiency of a seam welding machine lies not only in its welding qualities but in the use of a suitable jig to properly hold the work. The jig used should be made so as to enable the operator to place or remove the work in the shortest possible time, since the welding itself is very fast compared with any other known method of making a continuous joint.

In order that their seam welding machines may operate in every installation with the highest efficiency possible, the Thomson Electric Welding Co. build them standard only up to a certain point and then design a special holding jig to best fit the work to be done in each individual case. The amount of lap allowed in making lap seam welds is usually about twice the single sheet thickness of the metal.

The operation of a lap seam welding machine is very simple, once the machine is set for any given piece of work for which a special jig has been built. After placing the piece in the jig and securely locking it there, the operator depresses a foot-treadle which throws in a clutch and starts the copper roller across the work. By the proper setting of adjustable control-stops on the control-rod at the top of the machine, the current is automatically turned on as the roller contacts with the overlapping edges of the piece to be welded and is automatically turned off when the roller reaches the end of its stroke; another stop reverses the travel of the roller and brings it back to the starting position. The control-stops may be adjusted to turn the current on or off at any point along the stroke of the roller for doing work with a seam shorter than the maximum capacity of the machine. The roller stroke may be also shortened so that the complete cycle of operation will be accomplished in the shortest space of time on seams shorter than maximum seam capacity of any machine. In order to keep the copper roller from overheating in action, water is introduced through its bronze bearings on each side. This same water circulation, also passes through the under copper horn or mandrel and then through the cast-copper secondary of the transformer, so that the machine can be operated continually, 24 hours per day if desired, without overheating.

Lap Seam Welding Machines

The lap seam welding machine, known as Model 306, shown in Fig. 1 will weld a seam 6 in. long in soft iron or steel stock up to 20 gage in thickness, or brass and zinc up to 24 gage thick. This machine will make from 60 to 600 welds per hour, depending on the nature of the work and the quickness with which the pieces can be placed in and removed from the jig. The copper horn is water-cooled and has an inserted copper track on which the work rests. The upper contact consists of a

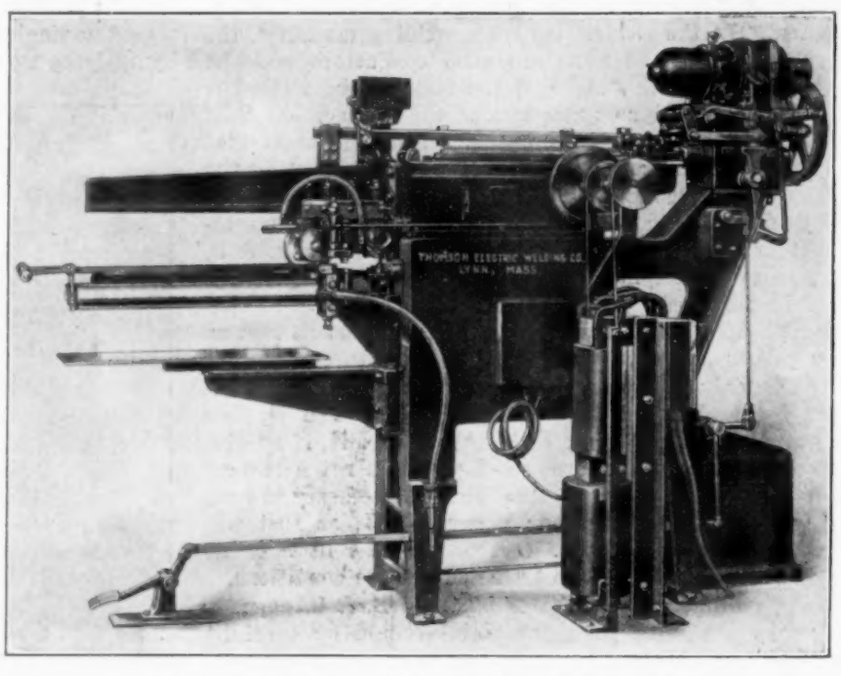


FIG. 4. LARGE SIZE, NO. 324, LAP SEAM WELDING MACHINE

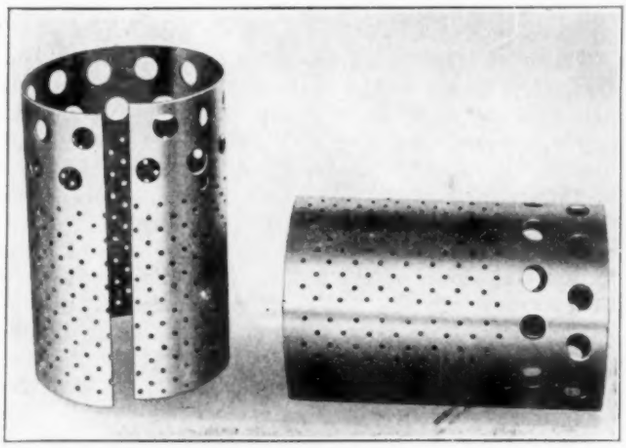


FIG. 5. OIL STOVE BURNER TUBES BEFORE AND AFTER WELDING

copper roller 6¼ in. in diameter, mounted on a knockout shaft supported in water-cooled bearings. Pressure is exerted on the copper roller by means of a series of springs on each side which are adjustable to give the proper tension for various thicknesses of stock. Current control is automatic through a magnetic wall switch carrying the main current. The latter is controlled from a mechanical switch which is thrown in or out by the action of the roller-carrying mechanism as it starts and completes the stroke for which it is set. Standard windings are for 220-, 440-, and 550-volt, 60-cycle, alternating current. Current variation for different thicknesses and kinds of stock, is effected through a regulator which gives 50 points of voltage regulation. A variable-speed ½-hp. motor gives a wide variation in the speed with which the roller may be fed over the work. The standard ratings for the machine are 15 kw. or 25 kv.-a., with 60 per cent. power factor. This machine covers 32 x 96 in. floor space, is 68 in. high and weighs 2750 lb.

A close-up view of the type of roller-carrying head used on all the lap seam welding machines, is shown in Fig. 2. In this view the roller is shown operating between the clamping bars of a special holding jig on the horn. As the roller itself occasionally requires smoothing off around its contacting surface, its bearing has been designed to knock out quickly so that removal and replacement of the roller is very simple and easy to accomplish. The cleaner the stock being welded is kept, the longer a roller will operate without requiring smoothing off, as dirt and scale on the stock cause a slight sparking as the roller passes along, which tends to pit up its contact surface.

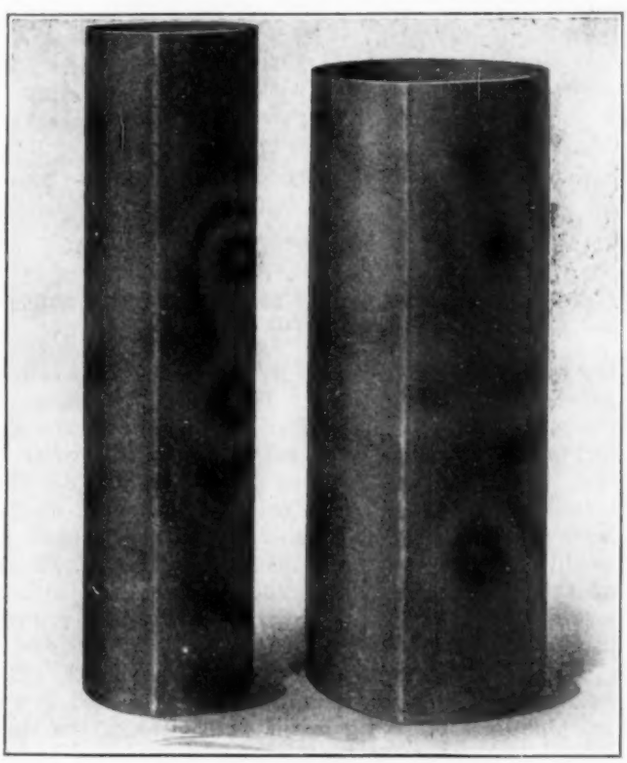


FIG. 6. SEAM WELDED AUTOMOBILE MUFFLER TUBES

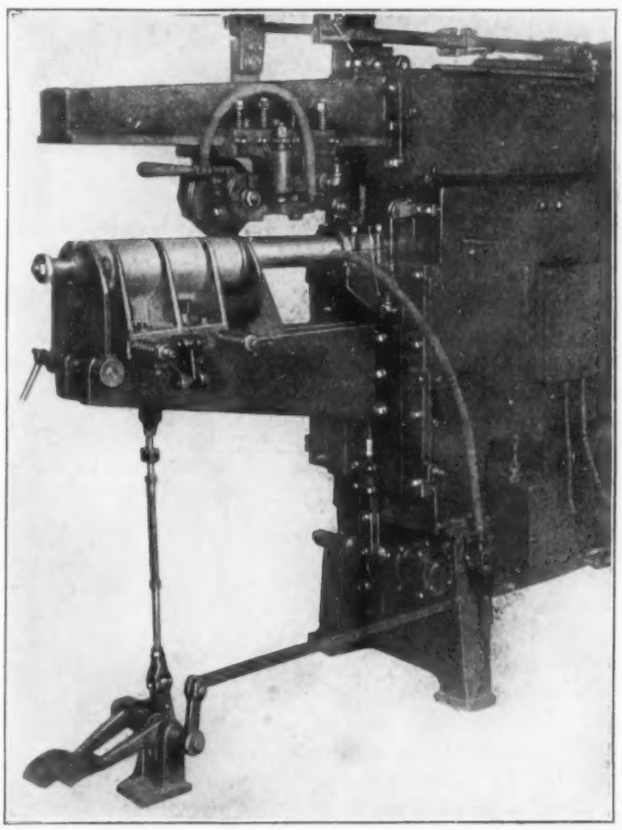


FIG. 7. HOLDING JIG FOR AUTOMOBILE MUFFLER TUBES

The machine shown in Fig. 3, known as Model 318, is a larger and heavier machine than the one previously described and will weld a lap seam 18 in. long on the same gages of metal quoted. Another very similar but smaller machine (Model 312) is also made for welding seams up to 12 in.

In Fig. 4 is seen a considerably larger machine, Model 324, capable of welding a lap seam up to 24 in. in length. The production is from 30 to 120 welds per hour. The machine covers a floor space of 36 x 90 in., is 72 in. high, and weighs 3500 lb. All other specifications are the same as given for Fig. 1, which is shown in the headpiece.

Examples of Holding Jigs

The machines shown may be fitted with numerous forms of holding jigs from the simple bar clamps shown on the horns in Figs. 3 and 4, to various more complicated forms, some of which may be mounted on the knee

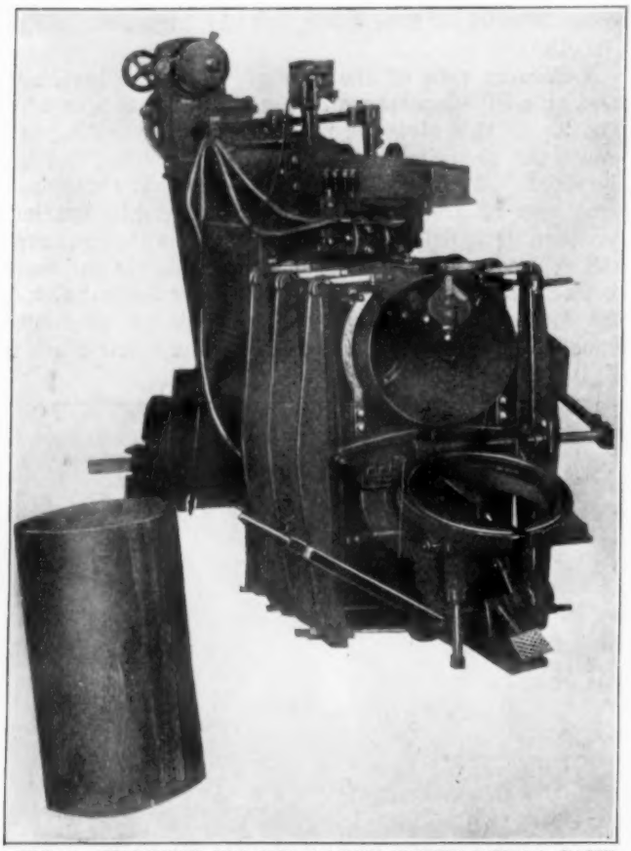


FIG. 8. HOLDING JIG FOR LARGE SHEET METAL CANS

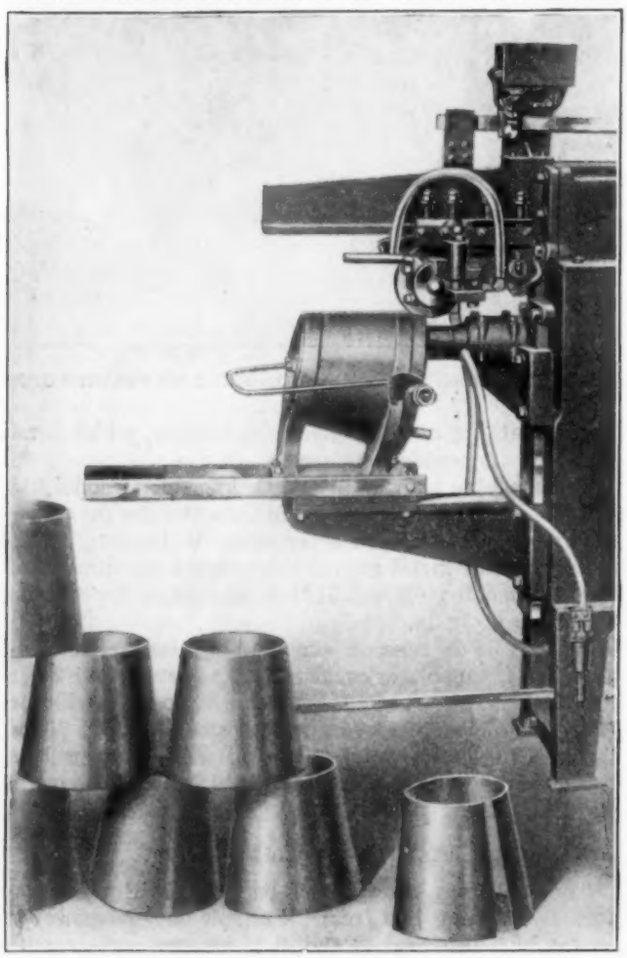


FIG. 9. JIG FOR HOLDING BUCKET BODIES

below the horn or bolted direct to the face of the machine column.

The small oil stove burner tubes shown in Fig. 5 lend themselves nicely to the seam welding process. Cylindrical pieces such as the shell tubes for automobile mufflers shown in Fig. 6, need a rather elaborate holding jig. A machine fitted up for this work is shown in Fig. 7. To insert a muffler shell into this jig the hinged end is swung outward and downward; the two halves of the holder are spread apart by pressing down on the left-hand treadle; the shell is then thrust into the holder; the treadle is released, which allows the holder sides to be pressed in by the springs and hug the muffler shell around the horn of the machine, with the edges overlapping enough for

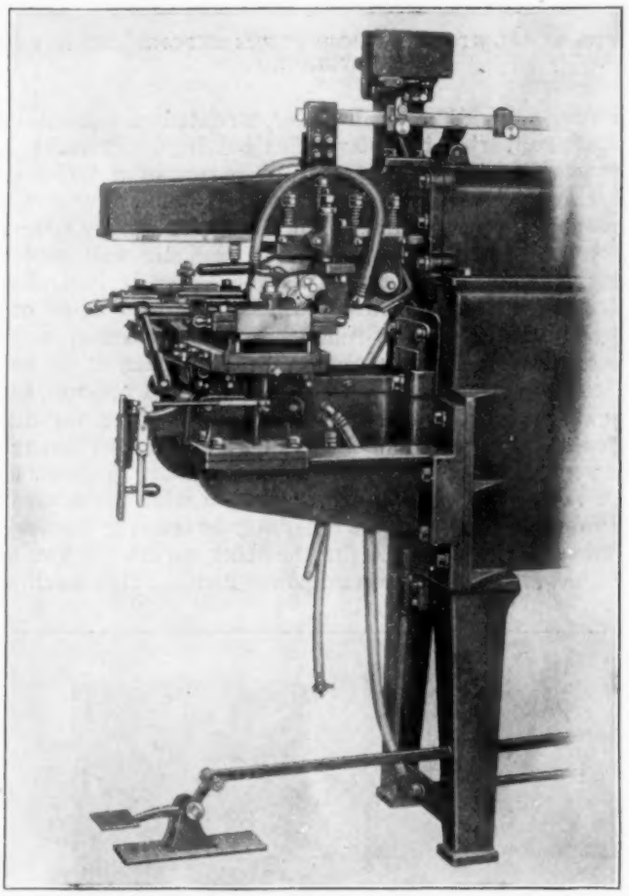


FIG. 10. JIG FOR WELDING ENDS OF METAL STRIPS TOGETHER

the weld; the end gate is then closed and the welding roller started over the seam. The principal function of the gate is to hold the muffler shell square in the jig and prevent it being pushed out by the welding roller.

A jig for holding large cans is shown in Fig. 8. The side clamps of this jig are operated by means of the lever shown at the left. An end gate, shown open, is used in the same way as in the muffler shell jig. Work of this kind is of course much slower than with a smaller jig, yet it is faster than by any other process of closing the seams.

Bucket bodies are held as shown in Fig. 9. The holding jig is made to slide in a channel bolted to the machine knee. The jig is slid back clear of the horn and, with the gate in the flaring end open, the bucket blank is inserted. The gate is then closed by means of

FIG. 11. MACHINE FOR FLANGE SEAM WELDING

the handle, the jig and work is pushed over the horn to a stop, and the weld is made as usual.

Another application of seam welding, is to use it for welding the ends of strip stock together, end to end, so as to facilitate continuous passage of the strip through the dies of a punch press. A machine fitted up for this work is shown in Fig. 10. The ends of the two strips to be welded are inserted in the jig from opposite sides and the edges brought together. The pieces are then clamped by means of the two levers shown in front of the jig, which operate eccentrics over the clamping plates. The welding roller is then run over the ends as in other work of this kind.

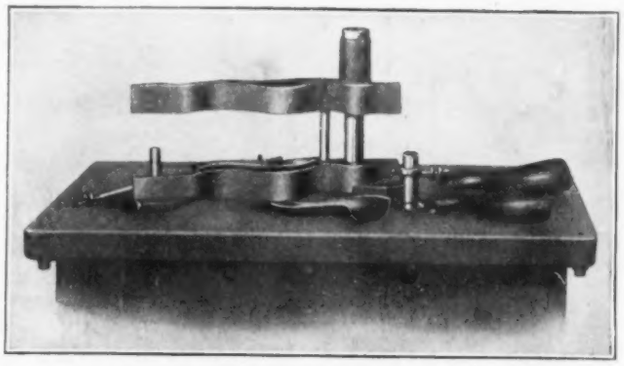


FIG. 12. JIG FOR HOLDING TEAPOT SPOUTS FOR WELDING

Flange seam welding differs from lap seam welding in that instead of the metal being lapped a slight fin or flange is formed along the edges of the metal parts, the flanges being welded together and practically eliminated in the process. This class of welding is especially adapted to the manufacture of light gage coffee and teapot spouts or similar work.

A machine built especially for flange seam welding, known as Model 26, is shown in Fig. 11. The work be-

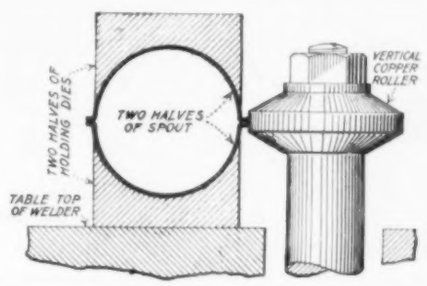


FIG. 13. DIAGRAM OF FLANGE SEAM WELDING OPERATION

ing done is the welding of the two halves of teapot spouts. In the operation the two halves of the spout are clamped securely in a special copper jig, Fig. 12, which has been carefully hand-cut to fit the halves of the spout perfectly on the entire contacting area. The jig is pushed around on the flat copper table, which constitutes the top of the welding machine, so that the seam

TABLE 1. COMPARATIVE THICKNESS AND APPROXIMATE CURRENT CONSUMPTION FOR 6-IN. SEAM

THICKNESS OF SINGLE SHEET				K.W.H. CONSUMED PER 1000 WELDS	COST PER 1000 WELDS @ 1c PER K.W.H.*	THICKNESS OF SINGLE SHEET				K.W.H. CONSUMED PER 1000 WELDS	COST PER 1000 WELDS @ 1c PER K.W.H.*
Decimals of inch	Decimals of Millimeter	B. & S. Std. Gauge	Birmingham Gauge			Decimals of inch	Decimals of Millimeter	B. & S. Std. Gauge	Birmingham Gauge		
.00394	10			.075	.0007	.02			25	.78	.0078
.00787	.2			.175	.0017	.0201		24		.78	.0078
.01002		30		.25	.0025	.022			24	.95	.0097
.01126		29		.3	.003	.02257		23		.975	.0097
.01181	.3			.35	.0035	.02362	.6			1.05	.0105
.012			30	.35	.0035	.025			23	1.175	.0117
.01264		28		.375	.0037	.02535		22		1.257	.0126
.013			29	.4	.004	.02756	7			1.35	.0135
.014			28	.45	.0045	.028			22	1.4	.014
.01419		27		.46	.0046	.02846		21		1.425	.0142
.01575	.4			.525	.0052	.03149	8			1.65	.0165
.01594		26		.55	.0055	.03196		20		1.7	.017
.016			27	.56	.0056	.032			21	1.7	.017
.0179		25		.675	.0067	.035			20	1.925	.0192
.018			26	.68	.0068	.03543	9			1.95	.0195
.01968	.5			.75	.0075	.03589		19		2.	.02

* Multiply these values by the rate you are paying per K. W. Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

FIG. 14. A FINISH WELDED TEAPOT SPOUT

of the edge to be welded is allowed to ride along the small power-driven copper roller which is mounted on a vertical shaft, as illustrated in Fig. 13. The halves which are welded by this process must be blanked out by special steel dies to give the correct amount of fin or flange on each edge. This fin is heated to the plastic stage by contact with the roller and the slight pressure applied not only forces the metal of the two fins to cohere but also forces the projection into a level with the outer surface of the spout, thus giving a finished job direct from the welder which is smooth enough without any grinding to be ready for the enamelling or agate-coating process.

The secret of success of this work lies wholly in the proper preparation of not only the copper holding-dies, but also the steel flanging and forming dies. A finished spout, just as it comes from the welding machine, is shown in Fig. 14. The welded seam is barely visible.

In order to assist those who have welding jobs to do, to calculate the current cost on various jobs, Table I is given. This table shows the approximate current consumption, and multiplying the rate given by the local rate charged, the cost of 1000 welds can be easily ascertained.

Table II is very convenient for ascertaining the size of copper wire needed to connect the different machines mentioned to the main source of current supply.

TABLE II. SIZE OF COPPER WIRE TO USE TO CONNECT UP THE WELDING MACHINE
(Where the machine is not over 150 ft. from source of supply)

Type Machine	K.V.A. Demand	220-Volt Circuit		440-Volt Circuit		550-Volt Circuit	
		Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses
No. 26	8	No. 12 B. & S.	35 Amp.	No. 14 B. & S.	20 Amp.	No. 14 B. & S.	15 Amp.
No. 306 No. 312 No. 318 No. 324	25	No. 4 B. & S.	100 Amp.	No. 10 B. & S.	50 Amp.	No. 10 B. & S.	50 Amp.

Group Insurance

BY A. J. SCHNEIDER

Perhaps a few figures and facts giving information on the Cincinnati Planer Co.'s first year's experience with group insurance may be of interest to those who are making an effort to reduce labor turnover. The shop is located in a suburb of Cincinnati, "out in the country where the sun shines," with good transportation facilities and first-class working conditions.

The group life insurance became effective in October, 1917, and the following information refers to the one-year period from Oct. 1, 1917, to the end of September, 1918. The amount of insurance is based upon length of service, beginning with $500 for three months' service and ending at $1,500 for nine years or more of service.

It was thought at first that one weakness of the plan might be that after receiving the policy and putting it away the employee would lose interest and forget about it. This would often be the case if the policy were simply presented to the employee and nothing else done about it. But there are several important factors that make it impossible for employees to lose interest or forget. When the applicant is hired the employment department explains the plan, shows him a framed sample policy which hangs in a conspicuous place, presents him with an Employee Instruction and Rule Book and directs him to take it home to study. The policy itself is good looking and simple, and the monthly shop bulletin, which is mailed to the homes, affords a good opportunity as a constant reminder. The notice which is mailed when the amount of insurance increases is a pleasant memento, while death is the most forceful argument of all.

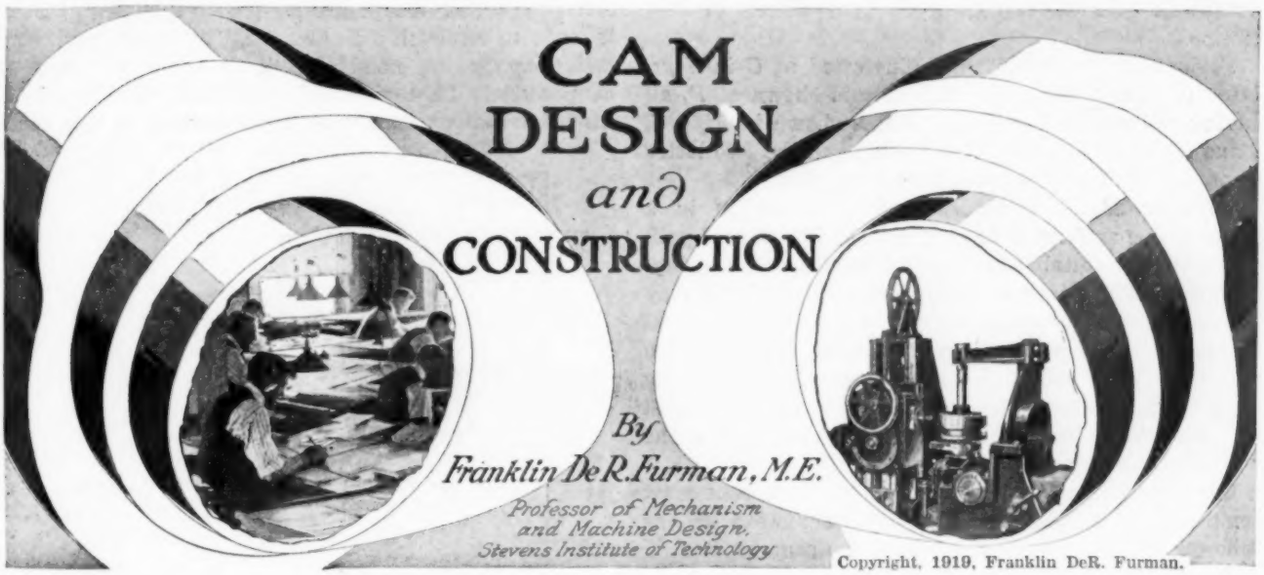
The only figures that can be given are on labor turnover, absence, lateness and cost of insurance. Other factors such as increased loyalty, good-will, coöperation, organization, etc., cannot and should not be weighed with figures. The company had four deaths during the one-year period on a payroll the average number of which was 660.

The labor turnover for the calendar year 1916 was 245 per cent., and for 1917 it was 171 per cent.; for the October-September period mentioned it was only 147 per cent.

Absence for 1916 was 5.9 per cent. and lateness 3.1 per cent.; for 1917 the figures were 5.8 and 3.2 respectively, while for the October-September period they were 6.2 and 3.9 per cent.

It is not claimed that group insurance is the only factor influencing these figures and values, nor do we know how to figure exactly what part of the improvement is due to insurance. It is simply a matter of study and good, liberal, square-deal judgment. The cost per employee was $5.13 for one year. This amount of course will vary according to the average age and insurance amount.

Possibly some day many plants will establish a sinking fund and carry their own life insurance. This could be done by a company that at all times has the complete confidence of its employees and that could find some way to take care of the remote possibility of an epidemic or catastrophe. Basing this plan on the law of averages this would be comparatively easy.



I. Introduction and Types of Cams

This series of articles is presented with a view to placing before the reader the whole subject of cam design on a systematic scientific basis. The first few articles include as much of the author's work on "Elementary Cams" (John Wiley & Sons, Inc.) as is considered necessary to an understanding and application of the fundamental principles on which the whole work is based. Later articles will contain much additional material that is also entirely new on the subject of cam design and construction.

WITH the constant increase of automatic machinery in practically the whole range of manufacturing industry the matter of form and size of the cam calls strongly for a comprehensive method of technical analysis. Such analysis becomes more and more important as automatic devices or machines are designed to operate at higher speeds.

Of the vast number of cams in use in industrial manufacturing plants particularly it is quite certain that a large majority have been formed entirely "by eye" as a result of experience and successive trials and without recourse to technical analysis or systematic computation. The entire development of cam work has been practically individualistic without a common thread of principle running through it all. This is in sharp contrast to the technical development of the subject of toothed gearing, for example. Cams, considered on a scientific basis, have been more neglected in engineering books than any other of the important branches of mechanism. Even the nomenclature of the subject is in a chaotic state, the same types of cams being known by various names in different localities—some of them not far apart.

This series of articles has been prepared with a view to gathering the various types of cams that are in common use in some comprehensive and orderly manner, and then pointing out how to design one of each class for proper form and size. The first few installments will include practically all of the base curves that are in common use in industrial manufacturing work, and will enable the cam designer to lay down his plans with a foreknowledge of what may be expected in each case. In the later installments additional base curves for cams will be introduced, some of them heretofore unknown and unused so far as the author has been able to observe. In addition, all of the cam types will be compactly grouped and analyzed for their adaptability for a given operation, particularly with reference to the minimum size of the cam and the relative velocities and accelerations of the follower member. This will be accomplished almost entirely with the use of simple arithmetical computations and with graphical methods of construction.

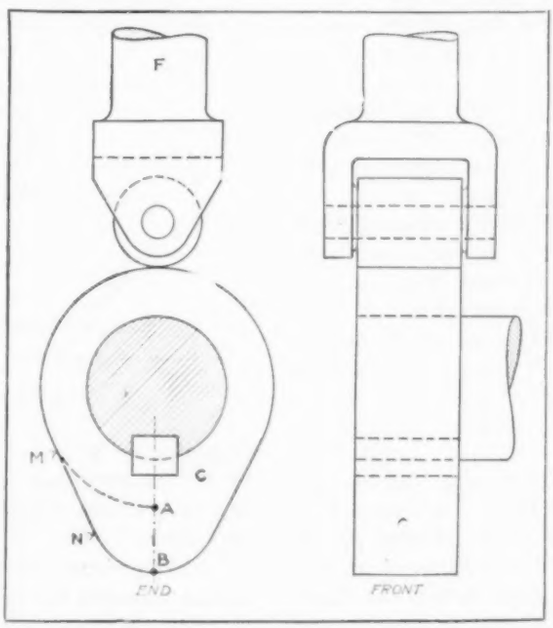


FIG. 1. RADIAL CAM AND FOLLOWER

Cams are rotating or oscillating pieces of mechanism having specially formed surfaces against which a follower slides or rolls and thus receives a reciprocating or intermittent motion such as

cannot be generally obtained by gear wheels or link motions.

Various forms of cams are illustrated at *C* in Figs. 1 to 10. The follower in each case is shown at *F*, all having roller contact except the ones shown in Figs. 7, 8 and 9a. The former has a V edge and the two latter have plane surfaces in contact with the cam.

Follower edges or rollers may have motion in a straight line as from *D* to *G*, Fig. 7, or in a curved path depending on suitably constructed guides or on swinging arms. The total range of travel of the follower may be accomplished by one continuous motion or by several separate motions with intervals of rest. Each motion may be either constant or variable in velocity, and the time used by the motion may be greater or less, all according to the work the machine has to do and to the will of the designer.

Cams may be most simply and at the same time most completely classified according to the motion of the follower with respect to the axis of the cam, as:

(*a*) Radial or disk cams, in which the radial distance

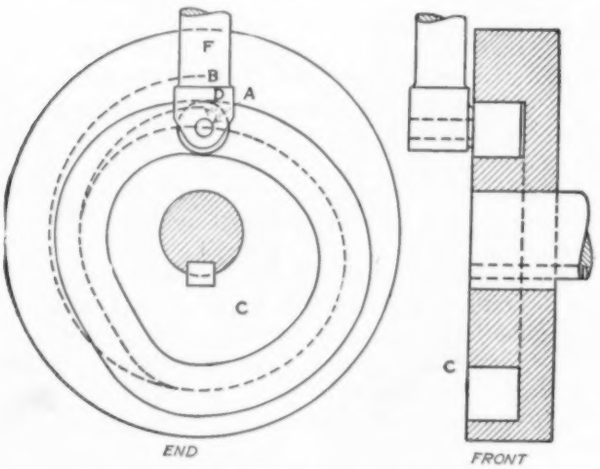


FIG. 2. FACE CAM AND FOLLOWER

from the cam axis to the acting surface varies constantly during part or all of the cam cycle, according to the data. The follower edge or roller moves usually in a radial, or an approximately radial, direction with respect to the cam. Various forms of radial cams are illustrated in Figs. 1, 2, 7, 8 and 9.

(*b*) Side or cylindrical cams, in which the follower edge or roller moves parallel to the axis of the cam or approximately in this direction. Several types of side cams are shown in Figs. 3, 4 and 10.

Nearly all the cams referred to in the above figures illustrating the two general classes of radial and side cams respectively have special or local trade names, which will be pointed out in later paragraphs.

(*c*) Conical and (*d*) spherical cams, in which the follower edge or roller moves in an inclined direction having both radial and longitudinal components with respect to the axis of the cam, as illustrated in Figs. 5 and 6.

Cams, according to popular usage, have generally come to be known by a wide range of names, the same cam often being designated by a number of different names according to geographical location and personal preference and surroundings of the cam builder or user This is an unfortunate condition, and in the general classification in the preceding paragraph an endeavor is made to establish a fundamental basis for clarifying and simplify the nomenclature of cams as much as as possible. In a work of this kind, however, it is essential tha⁺ at least the more common of the ordi-

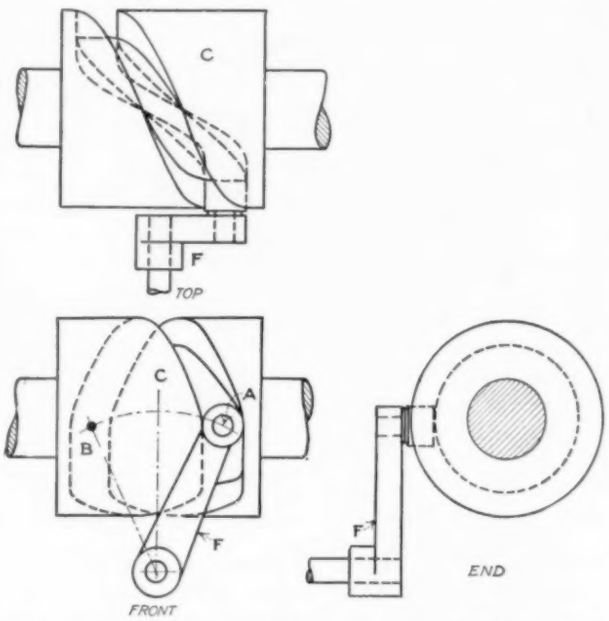


FIG. 3. CYLINDRICAL CAM AND SWINGING FOLLOWER

nary working terms be recognized and defined and that the cams under their popular names be properly placed in the fundamental classification given in the preceding paragraph.

The following specially named cams fall under the classification of radial cams:

(*e*) Periphery cams, in which the acting surface is

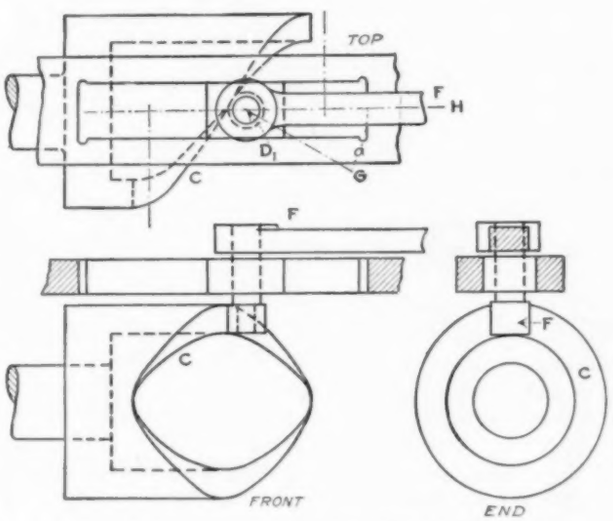


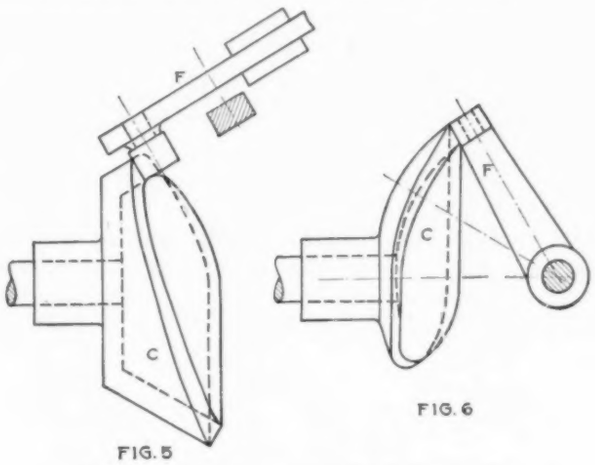
FIG. 4. END CAM AND FOLLOWER

the periphery of the cam, as illustrated in Figs. 1, 7 and 9. While these are examples of true periphery cams it must be recorded that the cylindrical grooved cam, shown in Fig. 3, is also known to some extent as a periphery cam, due no doubt to the fact that in designing this cam the original layout for the contour of the groove is first made on a flat piece of paper, which

is then wrapped on to the surface or "periphery" of the cylinder.

(*f*) Plate cams, in which the working surface includes the full 360 deg. and forms either the periphery of the cam or the sides of a groove cut into the face of the cam plate, as illustrated in Figs. 1 and 2 respectively. Figs. 7 and 9 also show plate cams.

(*g*) Tangential cam, in which a portion *MN* of the cam lobe, Fig. 1, is bounded by a straight line.



FIGS. 5 AND 6. TWO TYPES OF CAMS

Fig. 5—Conical cam with reciprocating follower. Fig. 6—Spherical cam with swinging follower

(*h*) Heart cams, in which the general form is that which the name implies (see Fig. 7). This type of cam is often so laid out as to give uniform velocity to the driver. In this case each half of the lobe is bounded by an Archimedean spiral with the ends eased off.

(*i*) Frog cam, in which the lobes are more or less irregular, as illustrated, for example, at *C* in Fig. 9.

(*j*) Mushroom cam, in which the periphery of a radial

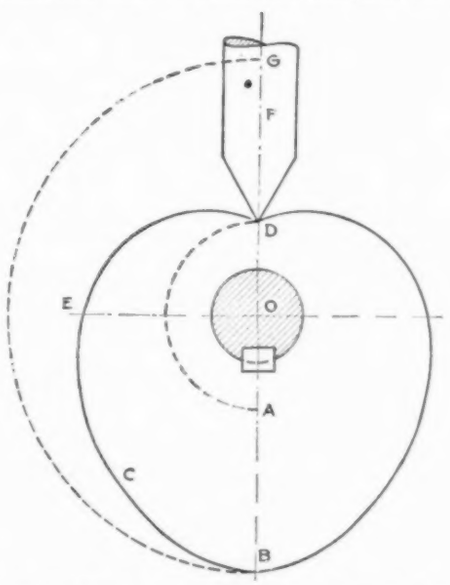


FIG. 7. HEART CAM AND FOLLOWER, SLIDING CONTACT

or disk cam works against a flat surface, usually a circular disk at right angles to the cam disk, instead of against a roller (see Fig. 9a).

(*k*) Face cam, also called a groove, but more properly a plate-groove, cam to distinguish it from the cylindrical-groove cam, in which a groove is cut into the flat face of the cam disk. In this form of cam, shown in Fig. 2, the roller has two opposite lines of contact, one against each side of the groove, when the roller has a snug fit. The plate or disk in which the groove is cut is generally circular; but it may be cast to conform with the contour of the groove or it may be built with radial arms supporting the irregular grooved rim. In the latter case it lacks resemblance to the face cam, but nevertheless it must, because of the nature of its action, be classed with it. The face cam, as ordinarily considered and as illustrated in Fig. 2, is better adapted for higher speeds because of its more nearly balanced form of construction. Against this, however, must be considered one of two disadvantages, either the high rubbing velocity of the roller against one side of the groove when the roller is a snug fit, or lost motion and noise as the working line of contact changes from one side of the groove to the other when the roller has a loose fit. The term groove cam might be applied with advantage

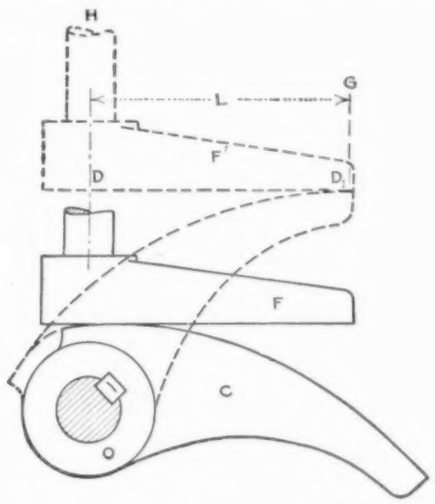


FIG. 8. TOE AND WIPER CAM

in clearness of meaning to such face cams as are cut or cast on noncircular plates.

(*l*) Wiper cam, which has an oscillating motion and is constructed usually with a long curved arm in order that it may "wipe" or rub along the plane surface of a long projecting "toe," or follower. The wiper cam is used generally to give motion to a follower which moves straight up and down, as shown from *F* to *F'* in Fig. 8. This, however, is not essential, and the follower may also have a swinging motion. The disadvantage of sliding friction, which is inseparable from the wiper cam, is balanced to some extent by the fact that the very sliding permits, within certain range, of the assignment of specified intermediate velocities between the starting and stopping points which cannot be obtained with similar forms of cams which have pure rolling action.

(m) Rolling cam, which greatly resembles the wiper cam in general appearance, but which is totally different in principle, for the curves of the cam and follower surfaces are specially formed so as to give pure rolling action between them. The rolling cam is specially well adapted to cases where both driver and follower have an oscillating motion and where the velocities between the starting and stopping points are not important and are not specified.

(*n*) Yoke cam, a form of radial cam in which all diametral lines drawn across the face and through the center of rotation of the cam are equal in length. This form of cam permits two opposite follower rollers, whose centers remain a fixed distance apart, to roll simultaneously on opposite sides of the cam and thus give positive motion to the follower. For illustration see Fig. 9.

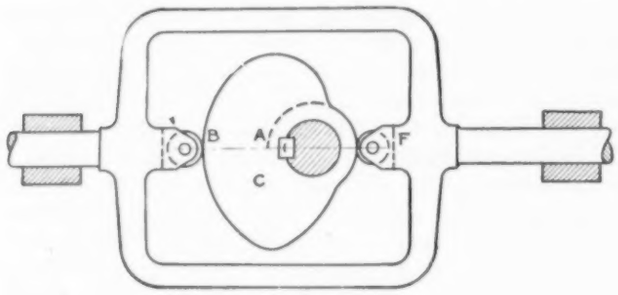


FIG. 9. YOKE CAM

Yoke cams may be and frequently are made of two disks fixed side by side, the peripheries being complementary to each other and the two rollers of the yoke rolling on their respective cam surfaces. The advantage of yoke cams is that they give positive motion with pure rolling of the follower roller, there being contact on only one side of the roller center in contradistinction to the double contact of the roller which exists in face and groove cams.

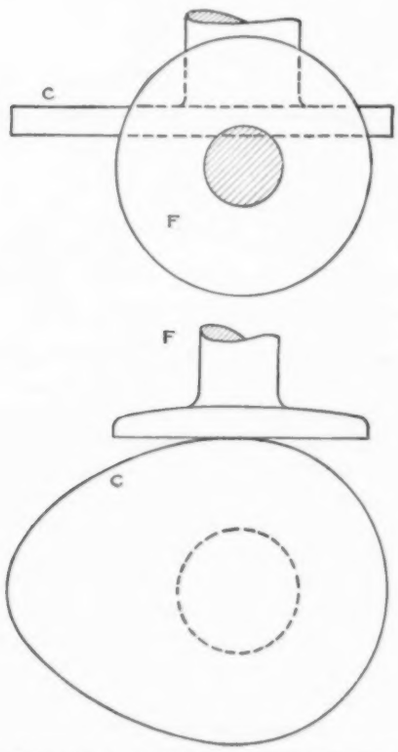


FIG. 9A. RADIAL CAM WITH MUSHROOM FOLLOWER

The following specially named cams fall under the general classification of side cams. These include cams that have been made from blank cylindrical bodies by using a rotary cutter with its axis at right angles to the axis of the cylinder and by moving the axis of the rotary cutter parallel to the axis of the cylinder while the cylinder rotates. A groove of desired depth is thus left in the cylinder, Fig. 3, or the end of a cylindrical shell is thus milled to a desired form, Fig. 4. A side cam may also be formed by screwing a number of formed clamps on to a blank cylinder, the sides of the clamps thus acting as the working surface as illustrated in Fig. 11. All types of side cams may properly be considered as derived from blank cylindrical forms, and therefore the name "cylindrical cam" could be regarded as synonymous with side cam; but general custom has limited the use of the term cylindrical cam to the barrel, or drum, type mentioned below:

(*o*) Cylindrical cam, also called barrel cam, drum cam or cylindrical-groove cam, in which the groove cut around the cylinder affords bearing surface to the two opposite sides of the follower roller, thus giving positive motion, as illustrated in Fig. 3.

(*p*) End cam, in which the working surface has been cut at the end of a cylindrical shell, or has been formed on the side surface of a circular disk, thus requiring outside effort such as a spring or weight to hold the follower roller against the cam surface during the return of the follower. An end cam is shown in Fig. 4.

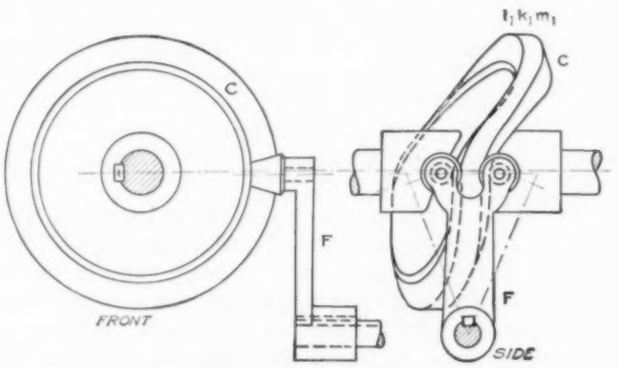


FIG. 10. DOUBLE-END CAM

(*q*) Double-end cam, in which a projecting twisted thread has been left on a cylindrical body, against both sides of which separate rollers on a follower arm may operate and thus secure positive motion. Instead of cutting down a cylinder to leave a projecting twisted thread it may be cast integral with a warped plate, as illustrated in Fig. 10, but this in no way changes its characteristic action.

There are a number of names in common use for cams, which cover both radial and side cams. Most prominent in this connection are those mentioned in the following paragraphs.

Box cam, designating a cam in which the follower roller is incased between two walls, as in the face cam, Fig. 2, or the cylindrical cam, Fig. 3. Literally box cams would also include yoke cams, in which the yoke would be the box. Box cams, because of their form of construction, give a positive drive.

Internal cam, in which there is only one working surface, and this is outside of the pitch surface. The internal cam corresponds to the internal gearwheel in toothed gearing. It may also be considered as a face cam with the inside surface of the groove removed, thus requiring that the follower roller should always be in pressure contact on the outside surface of the groove by means of a spring or weight, etc. Under some conditions of structural arrangements of the cam machine

the internal cam may be used to advantage where it will give a motion to a follower on the opposite stroke to that of the periphery cam, and it will also sometimes permit of a larger roller than the periphery cam.

Offset cam, in which the line of action of the follower rod, when extended, does not pass through the center of the cam, as would be the case, for example, if the center line *DG* of the follower rod in Fig. 7 were moved to the right or the left so that its extension would not pass through the center of rotation of the cam.

Positive-drive cam is one in which the cam itself drives the follower on the return as well as the forward motion. Many cams drive only on the forward motion of the follower, and depend upon gravity or the action of a spring to drive the follower in its return motion; such cams are illustrated in Figs. 1, 4, 5, 6, 7 and 8. Cams having positive drive, and therefore independent of gravity or springs, are illustrated in Figs. 2, 3, 9 and 10. It will be noted that positive-drive cams include the face, yoke, cylindrical and double-end types of cams; also that the box cam, although it includes some of these, should also be considered as a group name of the positive-drive type.

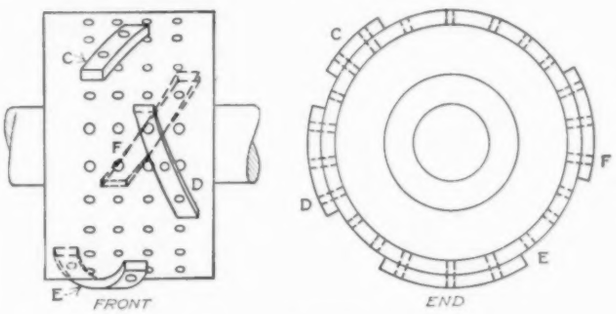


FIG. 11. BARREL CAM

Single-acting and double-acting cams comprise all forms of cams, the single-acting ones giving motion only in one direction and depending on a spring or gravity to return the follower. Double-acting cams have the follower under direct control all the time and are the same as positive-drive cams described in the preceding paragraph.

Cams which always give continuous motion to the follower from one end of the stroke to the other are called single-step cams. When the follower's motion in either of its two general directions is made up of two entirely separate movements it is called a double-step cam with reference to that stroke. If three or more separate movements are given to the follower while it moves in one general direction it is generally referred to as a multiple-step cam, or as a triple-step, quadruple-step cam, etc. Since a cam may be, for example, a double-step cam on the out or working stroke and a single-step cam on the return stroke such a cam may be referred to as a two-one-step cam, always giving the number referring to the working stroke first.

Adjustable cam, also called clamp cam, strap cam, dog cam, and carrier cam, in which specially formed pieces are directly bolted or clamped to any of the regular geometrical surfaces, usually to either the plane or cylindrical surfaces. In Fig. 12 the clamps are shown at *C* and *D* fastened to a disk. The cam, considered as a whole, belongs to the radial class. In Fig. 13 the clamps are shown at *C* and *D*, also fastened to a disk; but in this case the clamps, or dogs as they are usually called when used in this way, are so formed as to give a sidewise motion to the follower, and therefore this cam belongs to the side-cam class. In Fig. 11 clamps are shown at *C*, *F*, *E* and *D* fastened to a cylinder, and

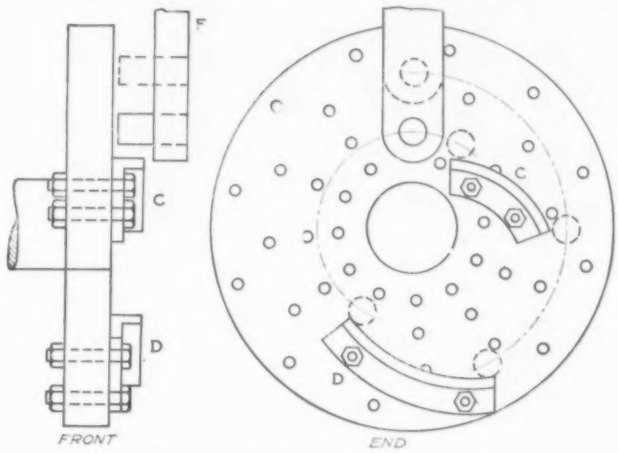


FIG. 12. ADJUSTABLE PLATE CAM

they are shaped to give the same action as a regularly formed end cam in the side-cam class. The type of cam illustrated in Fig. 11 is also known as an adjustable cylindrical or barrel or drum cam and is very widely used for regulating the feeding of the stock, and in operating the turret in automatic machines for the manufacture of screws, bolts, ferrules and small pieces generally that are made up in quantities.

Double-mounted or multiple-mounted cams are sometimes resorted to where several movements can be concentrated into small space. This consists merely in placing two or more of any of the cam surfaces described in the preceding paragraphs on one solid casting or cam body. For example, a face cam, a cylindrical and an end cam may all be cut on one piece.

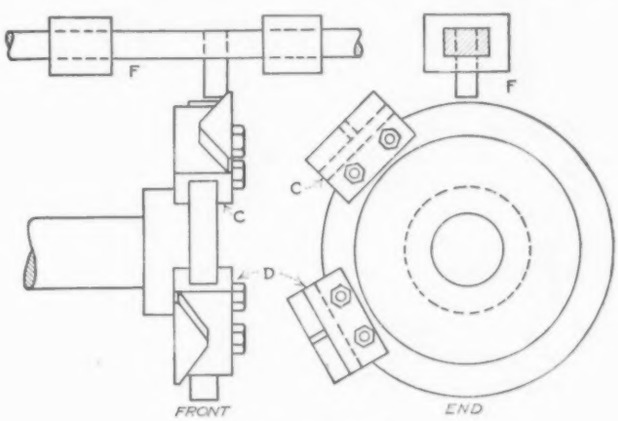


FIG. 13. DOG CAM

Oscillating cams, in which the cam itself turns through a fraction of a turn instead of through the entire 360 deg. While any type of cam may be designed to oscillate instead of rotate it is usually the toe-and-wiper and rolling forms of the radial type of cam that are known as oscillating cams.

Cams falling in the conical class have no special name other than the one here used. The spherical cams are

sometimes termed globe cams. Cams in conical and spherical classes are particularly useful in changing direction of motion in close quarters and in directions other than parallel and at right angles. In both Figs. 5 and 6 single-acting cams are shown, but it is apparent that, with thicker walls on both the cone and the sphere, grooves could be cut in them, thus giving positive-drive cams in both cases.

Summing up the general and special names for cams we have in tabular form:

- Cams
  - Box
  - Internal
  - Offset
  - Positive-drive
  - Single-acting
  - Double-acting
  - Step
  - Adjustable or strap
  - Dog or carrier
  - Multiple-mounted
  - Oscillating
  - *a* Radial or disk
    - *e* Periphery
    - *f* Plate
    - *g* Tangential
    - *h* Heart
    - *i* Frog
    - *j* Mushroom
    - *k* Face or plate-grooved
    - *l* Toe and wiper
    - *m* Rolling
    - *n* Yoke or duplex
  - *b* Side or cylindrical
    - *o* Cylindrical, grooved, barrel or drum
    - *p* End
    - *q* Double-end
  - *c* Conical
  - *d* Spherical or globe

Shop Democracy and Dividends

By John R. Godfrey

"Making the world safe for democracy" has become a bit threadbare in spots, having been used very promiscuously by many who haven't the slightest idea of what democracy means, unless it is voting for some particular man or party. But it applies to the machine shop just as well as to the nation, and the foremen who get wise to its application to their own job are on the road to climbing the ladder of machine-shop fame.

The foreman in the little old shop of yesterday was an autocrat with a capital A. The Kaiser had nothing on him in many ways. He could fire the best man in the shop if he didn't like the color of his necktie, if they differed in politics or religion, or bet on different horses. If the foreman's wife got up late and breakfast wasn't up to scratch, or the cakes were cold, or the milkman was late, woe betide the man or boy who ran foul of him. The cost to the firm never entered his head. He was boss, "by gosh," and he had to keep "discipline." He could damage a man's reputation and drive him out of town.

Of course in the long run the old man got his number and he walked the plank. But in the meantime he was monarch of all he surveyed and a bit more, and he could raise more hell with the output of a shop than even a double-dyed systematizer turned loose.

It was this petty despotism which led to the taking of the power of hiring and firing away from the foreman and putting it in the hands of an employment agent or manager. There are other reasons, of course, depending on the organization of the shop. But even with this work in other hands the foreman is in a position where a little insight into the meaning of democracy is a good thing to have.

In some shops the foreman is a work planner; in others a work chaser or animated bulletin board to tell the men when they are behind or playing safe; in some shops they are still instructors, as in the old days of apprenticeship. But no matter which of these he may be, a little tact in handling men, a little diplomacy if you please, goes a long way.

There is a Japanese proverb to the effect that it is often better to keep the man whose faults you know than to risk getting a new man of whose faults you know nothing. And it's a good thing to remember when you feel like firing a man for doing some fool stunt like reversing the machine to back the reamer out that he isn't apt to do the same thing a second time and that perhaps he had never been told of the damage it does to the reamer. Of course he ought to know, but the opportunities of learning except by observation are decidedly limited these days in most shops.

Then too we must make allowances for home conditions—for sickness or other difficulties. Of course it's nothing you or the shop is responsible for, but it happens just the same and you can perhaps imagine yourself in his place. When a man has a kiddie at home with diphtheria or his mother-in-law has the mumps he can't help letting his thoughts wander a bit, and it sometimes affects his work.

Different men have to be handled differently to get the best results. Here is where your tact and knowledge of human nature comes in. Some men require driving, but more can be led, coaxed or even "jollied." Certain types of workmen respond to inquiries about the children and the family in general. Don't balk and say it isn't your job, to play nurse or welfare worker to a bunch of kids. Your job is to get production, to turn out product that will pass inspection. If you can do this by asking after Johnny's toothache or Annie's measles, that's part of the job. In one case I know of, the foreman in a paper-box factory kept girls on the job by putting a cat in the room with them.

Keeping men on the job is another way of increasing production, or rather from preventing it from falling off. This is one of the things we have learned since the old days when the foreman fired right and left. Every time a man leaves your shop he takes with him some knowledge that he has learned while there, some knowledge that is more valuable to your shop than to any other. Of course he may have other qualities which offset this and make it pay to lose the experience he has gained, be it much or little. But it is always well to consider that a man should be worth more to you the longer he stays.

I know a work manager, of a large plant too, who preaches this gospel to all his foremen. In fact he preaches it so hard that a new foreman would have heart failure, if he had any new foremen, which he doesn't. No man gets to be a foreman under three to five years in that shop unless under unusual circumstances. They have to learn the ways of the shop, the spirit of the management and the quality of the product first of all.

This manager goes so far that he calls in a foreman and questions him when certain men in his department fail to get on the list of recommendations for a raise. Just imagine it! His theory is that if a man isn't worth more to the company at the end of six months or a year, there's something wrong. It may be with the foreman or with the man, but it's wrong anyhow. If it's the man the foreman should have found it out before. If it's the foreman's fault for not teaching him then the foreman wants to get busy himself.

How the 155-Mm. Howitzer Is Made—VII

By J. V. HUNTER
Western Editor *American Machinist*

The parts of the breech mechanism must be machined within very close tolerances. Upon their proper functioning when the gun is in action may depend the outcome of an engagement. In this final article of the series the methods used in their production are described and many of the jigs and fixtures used are illustrated.

THE regulating plate is placed on the upper face of the lower hinge lug on the howitzer body and takes the downward wear of the block carrier, due to the constant opening and closing of the breech mechanism. The sequence of operations is as follows:

Operation 1.—Bore, ream, turn hub, and face. Machine—17 in. by 6 ft. Le Blond lathe.
Operation 2.—Face opposite side, chamfer inside corner and thread. Machine—19 in. by 8 ft. Le Blond lathe.
Operation 3.—Mill outside edges; finish-mill corners. Machine—No. 4 Becker vertical milling machine.
Operation 4.—Caseharden.
Operation 5.—Grind hole. Machine—Modern internal grinding machine.
Operation 6.—Grind hub. Machine—Modern universal grinding machine.
Operation 7.—Grind hub face with face of wheel. Machine—Modern universal grinding machine.
Operation 8.—Surface-grind flat face. Machine—Modern universal grinding machine.

OPERATIONS ON THE REGULATING PLATE NUT

Operation 1.—Drill, chamfer, tap and face. Machine—17 in. by 6 ft. Le Blond lathe. Tools—Gages, special taps, thread gages.
Operation 2.—Turn diameter and finish opposite face. Machine—18 in. by 8 ft. Mueller lathe. Tools—Snap gages.
Operation 3.—Mill wrench slots. Machine—No. 10 Pratt & Whitney hand-milling machine. Tools—Holding fixture, gage.
Operation 4.—Bench work.
Operation 5.—Caseharden.

The block-carrier hinge-bearing plate is similar in appearance to the regulating plate, and fills a corresponding service on the lower side of the hinge lug of the block carrier. The operations follow:

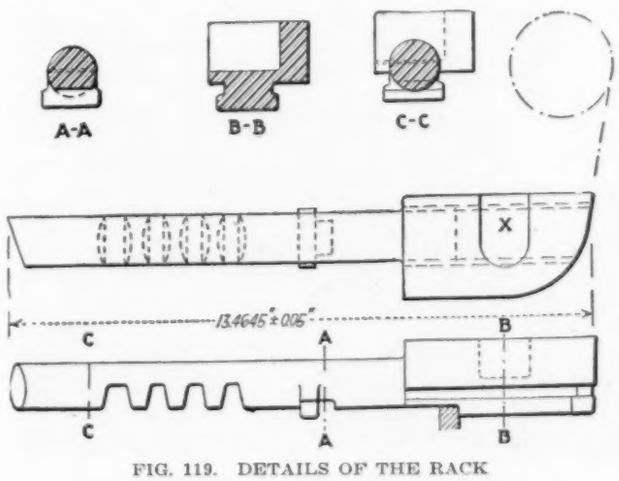


FIG. 119. DETAILS OF THE RACK

Operation 1.—Drill, bore, ream, turn and face lug side. Machine—17 in. by 6 ft. Le Blond lathe. Tools—Rose reamers, plug gages.
Operation 2A.—Mill flat side. Machine—No. 2 Cleveland plain-milling machine. Tools—Milling fixture.
Operation 2B.—Countersink. Machine—Henry & Wright drilling machine. Tools—Special countersinks.
Operation 3.—Drill holes and counterbore. Machine—Henry & Wright drilling machine. Tools—Counterbores, gages.
Operation 4.—Mill edges. Machine—No. 12 Pratt & Whitney profiling machine. Tools—Milling fixture.
Operation 5.—Caseharden.
Operation 6.—Grind flat face. Machine—No. 2 Brown & Sharpe surface grinding machine. Tools—Holding fixture.
Operation 7.—Grind hole. Machine—10 x 10 Modern internal grinding machine. Tools—Gages.
Operation 8.—Grind lug side. Machine—No. 3 Modern universal grinding machine. Tools—Gages.

BLOCK-CARRIER HINGE-BEARING-PLATE SCREWS

Operation 1.—Turn thread and cut off. Machine—No. 1 Brown & Sharpe screw machine. Tools—Box tools, Magic chuck, gun taps, cut-off tools.
Operation 2.—Slot head. Machine—No. 10 Pratt & Whitney hand-milling machine. Tools—Slitting saws.

BLOCK-CARRIER LEVER CATCH

Operation 1.—Mill two flat sides. Machine—No. 3 Cincinnati plain-milling machine.

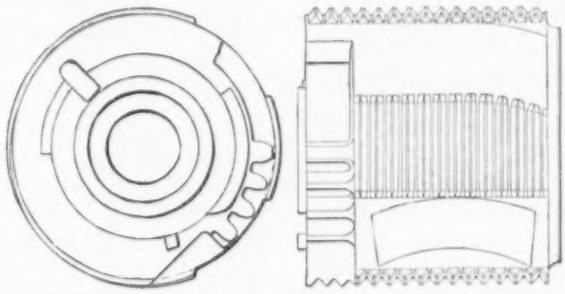


FIG. 121. DETAILS OF THE BREECH BLOCK

Operation 2.—Profile dovetail edges. Machine—No. 12 Pratt & Whitney profiling machine. Tools—Gages.
Operation 3.—Mill angle edge. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages.
Operation 4.—Mill angle cut on end. Machine—No. 3 Cincinnati plain-milling machine.
Operation 5.—Bench work.
Operation 5A.—Assemble.
Operation 6.—Caseharden.

BLOCK-CARRIER-LEVER CATCH SCREW

Operation 1.—Turn, thread and cut off. Machine—No. 1 Brown & Sharpe screw machine. Tools—Gages, box tools, Magic chuck, taps, cut-off tool.
Operation 2.—Mill square head. Machine—No. 10, Pratt & Whitney hand-milling machine.

BLOCK-CARRIER ASSEMBLING STUD

Operation 1.—Turn and cut off. Machine—No. 1 Brown & Sharpe screw machine.
Operation 2.—Mill flats. Machine—No. 10 Pratt & Whitney hand-milling machine.

The large end of the rack, Fig. 119, has a socket *X* which connects with the operating lever, and the final motion of this lever in closing the breech imparts the

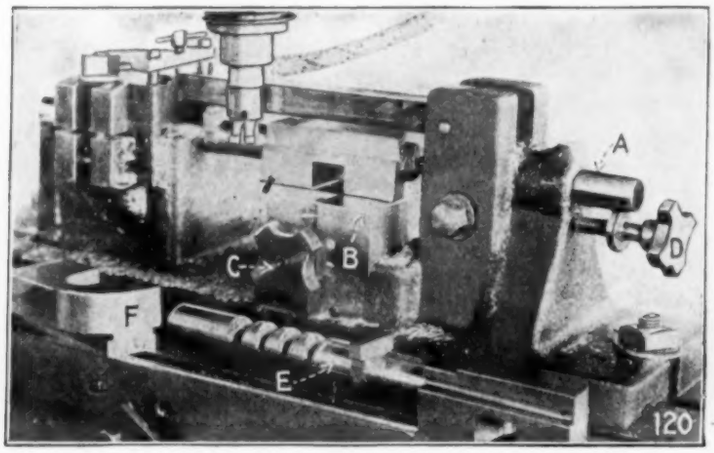


FIG. 120. MILLING FIXTURE FOR RACK

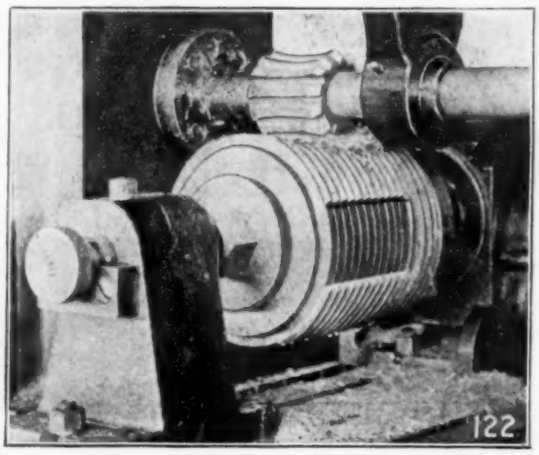


FIG. 122. INTERRUPTING A THREAD

necessary movement to the rack to rotate the breech block. The operations of the rack are as follows:

Operation 1.—Center. Machine—18 in. by 8 ft. Prentice lathe.
Operation 2.—Rough-turn shaft. Machines—18 in. by 8 ft. Prentice lathe and 21 in. by 8 ft. Le Blond lathe. Tools—Special.
Operation 3.—Rough-grind to a size and finish-grind face of stop for location point for all future operations. Machine—No. 3 Modern universal grinding machine. Tools—Gages.
Operation 4.—Rough-mill top and sides. Machine—No. 3 Cincinnati plain-milling machine.
Operation 5.—Rough-mill bottom, slide and stop. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages.
Operation 6.—Rough-mill opposite stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 7.—Rough-mill opposite stop. Machine—No. 5C Becker vertical milling machine. Tools—Profile fixture.
Operation 8.—Mill rack teeth. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages, cutters.
Operation 9.—Straighten.
Operation 10.—Finish-grind. Machine—No. 3 Modern universal grinding machine.
Operation 11.—Finish-mill top and sides. Machine—No. 3 Cincinnati plain-milling machine. Tools—Gages.
Operation 12.—Finish-mill bottom, slide and stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 12A.—Finish-mill T on slide. Machine—No. B Becker vertical milling machine. Tools—Slot centers, gages.
Operation 13.—Finish-mill opposite stop. Machine—No. 3 Cincinnati plain-milling machine.
Operation 14.—Finish-mill slot and profile end. Machine—No. 5C Becker vertical milling machine. Tools—Gages.
Operation 15.—Finish-mill both stop faces. Machine—No. 3 Cincinnati plain-milling machine.
Operation 16.—Bench work.
Operation 17.—Caseharden.
Operation 18.—Straighten.

One of the milling fixtures for holding the rack is shown in Fig. 120. This is for operations 11, 12 and 12A, and combines a centering device *A* with an adjustable plate *B* to take up the downward pressure during the milling cut. The adjustment of this surface plate is by the knob *C*, and the center has a similar screw adjustment *D*. Two views of the rack are shown; one at *E* shows the teeth milled in its stem, and the piece *F* shows the grooves of the T-section.

The rack lock prevents the rack from moving when the breech is open. Closing the block carrier pushes the lock back by pressure against the breech end of the gun, releases the rack, allowing it to rotate the breech block. The sequence of operations on the rack lock are as follows:

Operation 1.—Straddle-mill two flat surfaces and edge. Machine—No. 12 Brown & Sharpe plain-milling machine.
Operation 2.—Mill inside radius. Machine—No. 12, Brown & Sharpe plain-milling machine.
Operation 3.—Mill convex edge. Machine—No. 12 Brown & Sharpe plain-milling machine.
Operation 4.—Cut off square. Machine—No. 2B Milwaukee plain-milling machine.
Operation 5.—Drill and ream. Machine—Henry & Wright drilling machine.
Operation 6.—Straddle-mill ends. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7.—Mill-stop edge. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7A.—Bench work.
Operation 8.—Caseharden.
Operation 8A.—Polish.

THE BREECH BLOCK

In drilling the breech block, Fig. 121, for the assembling stud the hole must be located by the position of the thread and all following operations are then performed on fixtures which locate the piece in reference to the position of this hole. The jig used for locating the relative position of the thread and assembling stud hole incloses the entire threaded section of the breech block and locates the thread position when it bottoms in the jig. Interrupting the thread is shown in Fig. 122.

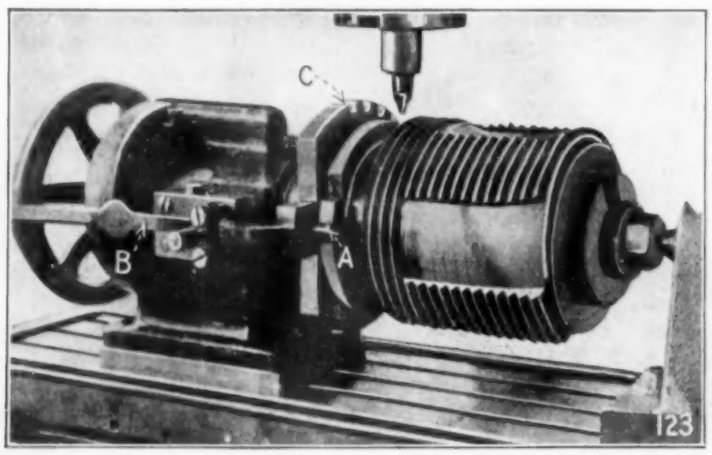


FIG. 123. CUTTING THE GEAR TEETH

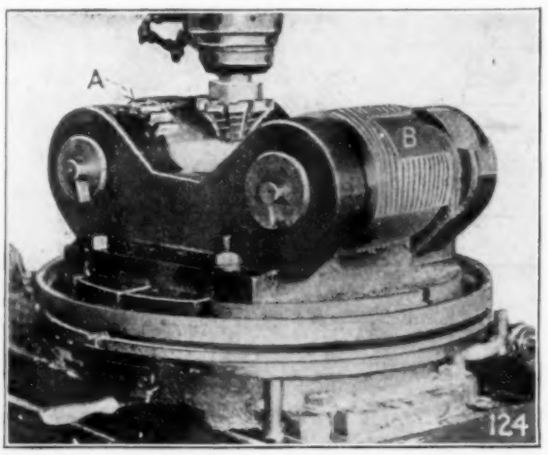


FIG. 124. MILLING SWING CLEARANCE

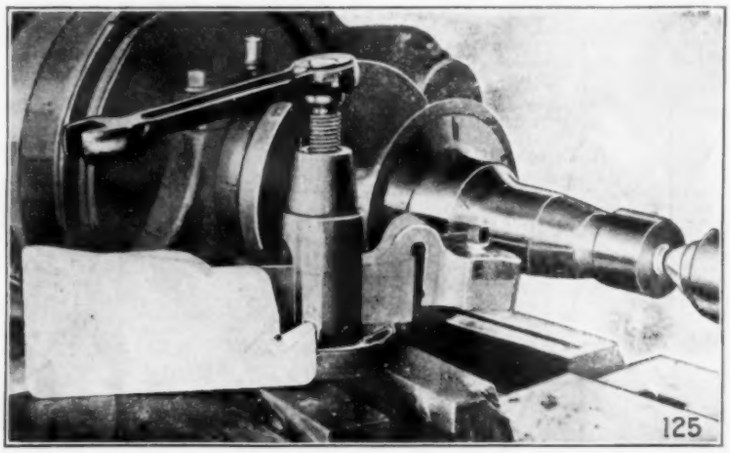


FIG. 125. TURNING THE OBTURATOR SPINDLE

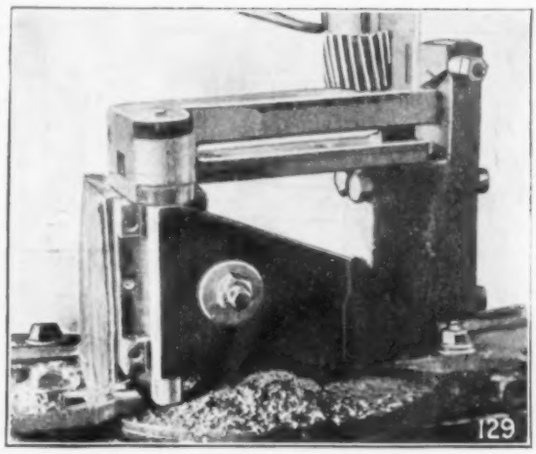


FIG. 129. FINISH-MILL

The cut here shown is the roughing cut and is followed by a finish cut to the correct depth of sector.

Cutting the gear teeth in the breech block is shown in Fig. 123. In the position shown the fixture has been revolved beyond its operating point to indicate the method of control by the stop at *A*. The lever latch *B* engages the notches *C* in the index plate, which is clamped to the breech block.

Machining the swing clearance on the breech block is illustrated in Fig. 124. Two breech blocks are held in

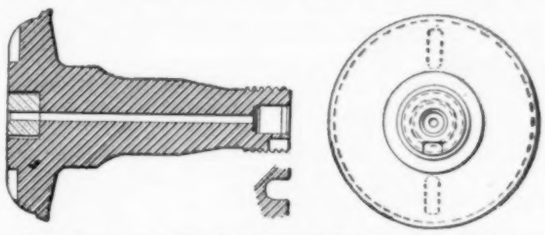


FIG. 126. OUTLINE OF OBTURATOR SPINDLE

this fixture at the same time, although the cutter works on each singly. The fixture is mounted on a revolving table so centered that when it is revolved the proper curvature for swing clearance is produced in the sectors of the block. After making the cut on block *A* the work is moved to the left sufficiently to make the cut on the block *B*. After these cuts have been made on two blocks they are removed and replaced, one for the other, and the following cut made on each. Later the clearance cuts are similarly made on the lower sides of the blocks.

The complete operations for machining the breech block are as follows:

Operation 1.—Drill, rough-face and rough-turn. Transfer heat number to outside diameter. Machine—No. 3A Warner & Swasey turret lathe.

Operation 2.—Rough turn other end; rough and finish bore

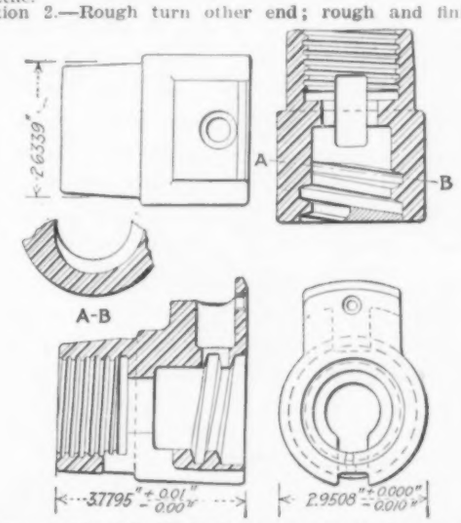


FIG. 127. DETAILS OF FIRING-MECHANISM HOUSING

and counterbore gear end. Machine—No. 3A Warner & Swasey turret lathe.

Operation 3.—Finish turn and face ends. Transfer heat number with 1.8-in. stencils to muzzle and concentric with and as close as possible to bore. Machine—21 in. by 8 ft. Le Blond lathe.

Operation 4.—Thread. Machine—24 in. by 10 ft. Prentice lathe.

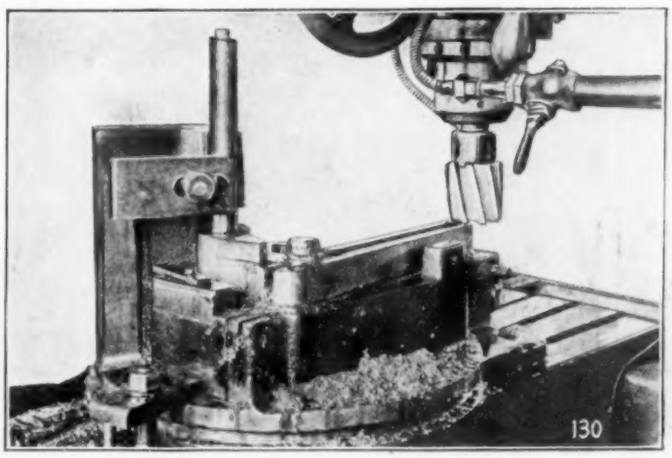


FIG. 130. MILLING THE BOTTOM FACE

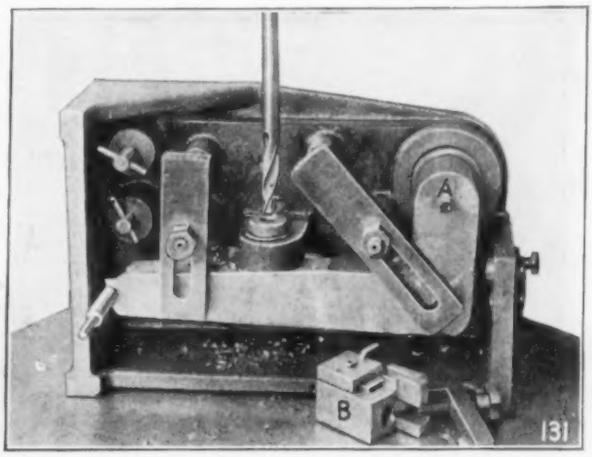


FIG. 131. DRILLING OPERATIONS

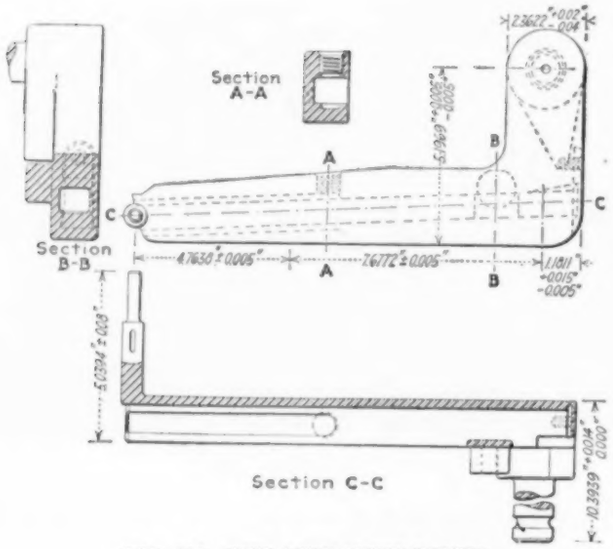


FIG. 128. THE OPERATING LEVER

Operation 5.—Drill hole for assembling stud. Transfer heat number to breech end opposite assembling stud hole concentric with and as close as possible to collar to read as from center bore. Machine—12-in. two-spindle Henry & Wright drilling machine.

Operation 6.—Mill sectors. Machine—No. 3 Kempsmith plain-milling machine.

Operation 7.—Mill square corners in two sectors. Machine—No. 5C Becker vertical milling machine.

Operation 8.—Shape clearance on sectors; transfer heat number to upper face of right-hand thread segement, stamping to read as from center of cross-section of breech block. Machine—No. 5C Becker vertical milling machine.

Operation 9.—Mill clearance gear teeth. Machine—No. 5C Becker vertical milling machine.

Operation 10.—Rough and finish gear teeth. Machine—No. 5C Becker vertical milling machine.

Operation 11.—Mill cam slot. Machine—Model B Becker vertical milling machine.

Operation 12.—Counterbore 3-in. diameter. Machine—No. 3A Warner & Swasey turret lathe.

Operation 13.—Bench work.

THE OBTURATOR SPINDLE

The obturator spindle is made from a forging and the operations are nearly all lathe work. One of the form-turning operations is illustrated in Fig. 125, showing a spring-tool and profile gage used in the work. The outlines of this piece are shown in Fig. 126 and the operations are as follows:

Operation 1.—Cut off boss and center. Machine—19 in. by 8 ft. Le Blond lathe; transfer heat number to face head end.

Operation 2.—Turn 3.75 in. and 2.65 in. spots to a size. Machine—19 in. by 8 ft. Le Blond lathe. Tools—Gages.

Operation 3.—Drill small center hole. Machine—12-in. Henry & Wright drilling machine. Tools—Plug gages.

Operation 4.—Recenter ends. Machine—Saxer-Creider speed lathe. Tools—Pilot countersinks.

Operation 4A.—Rough-turn all over. Machine—16 in. by 6 ft. Prentice lathe. Tools—Gages, forged tools.

Operation 5.—Finish-turn all over. Machine—18 in. by 8 ft. Prentice lathe. Transfer heat number to taper bearing back of thread section. Tools—Radius gages, snap gages, forming tool.

Operation 6.—Mill slots in head. Machine—No. 3B Becker vertical milling machine. Tools—Gages.

Operation 7.—Grind. Machine—No. 3 Modern universal grinding machine. Tools—Snap gages.

Operation 8.—Chase thread. Machine—18 in. by 6 ft. Prentice lathe. Tools—Gages.

Operation 9.—Inside thread in small end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Gages, counterbores.

Operation 10.—Inside thread large end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Plug gage, special tap.

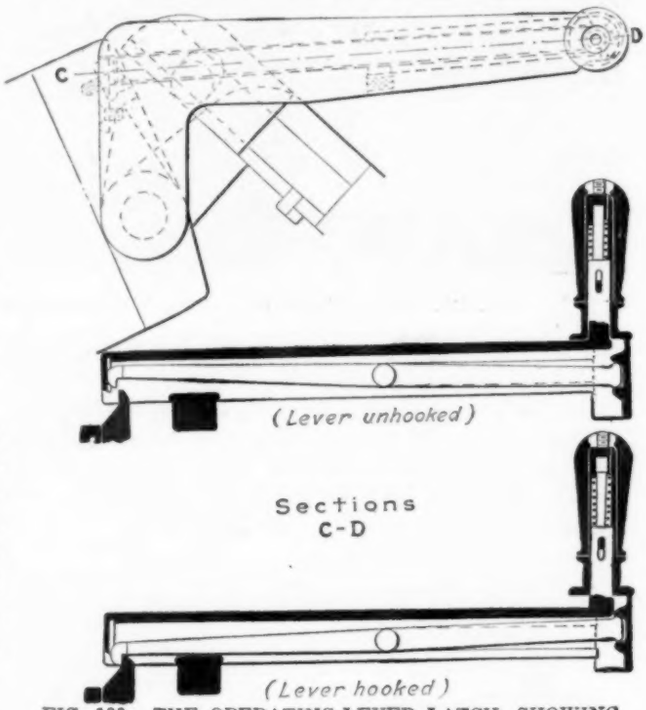


FIG. 133. THE OPERATING-LEVER LATCH, SHOWING METHOD OF ITS OPERATION

Operation 11.—Mill locking slot and remove fins. Machine—No. 3B Becker vertical milling machine.

Operation 12.—Assemble plug and vent bushing and gasket, face-off vent bushing, countersink ream hole in bushing and gasket. Machine—18 in. by 8 ft. Prentice lathe. Stamp heat number $\frac{1}{4}$ in. away from and concentric with diameter of vent plug to read as from center of plug. Tools—Wrenches.

THE FIRING-MECHANISM HOUSING

The firing-mechanism housing which engages and holds the obturator spindle in place is shown in Fig. 127. The sequence of operations follows:

Operation 1.—Heat-treat forging.

Operation 2.—Turn, face, bore, ream, counterbore and thread taper end. Machine—No. 4 Warner & Swasey turret lathe with tapping and chasing attachments.

Operation 3.—Turn, face and counterbore opposite end. Machine—16 in. by 6 ft. Reed lathe.

Operation 4.—Mill Acme thread. Machine—Pratt & Whitney thread-milling machine.

Operation 5.—Turn 2.065 in. and 2.5394 in. radius and face back projecting section. Machine—Reed lathe.

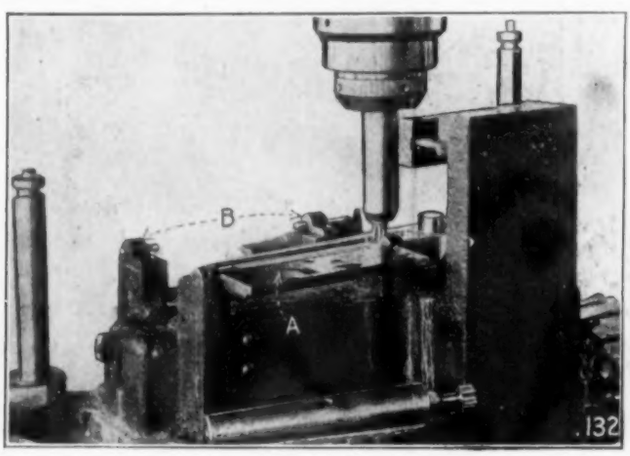


FIG. 132. SLOTTING THE LEVER

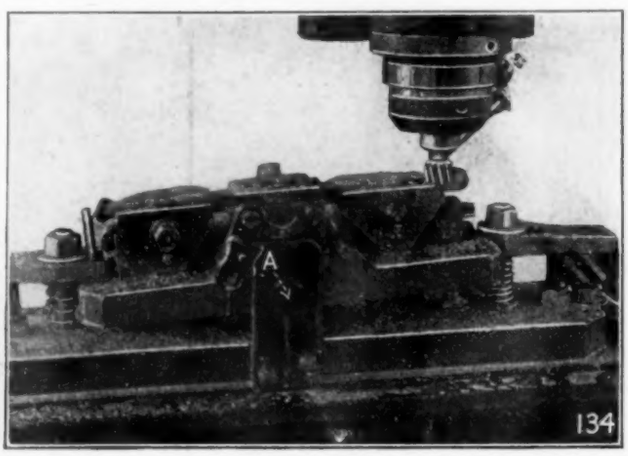


FIG. 134. A TILTING FIXTURE

Operation 6.—Form mill sides of plug. Machine—No. 2 Rockford plain-milling machine.
Operation 7.—Profile mill. Machine—No. 2 Cincinnati vertical milling machine.
Operation 8.—Drill, counterbore and tap all holes. Machine—12-in. Henry & Wright drilling machine. Tools—Counterbores.
Operation 9.—Mill key slot. Machine—12-in. Henry & Wright drilling machine. Tools—Gages.
Operation 10.—Slot. Machine—6-in. Pratt & Whitney slotting machine. Tools—Holding fixture; plug gages.
Operation 11.—Slot clearance on Acme thread. Machine—6-in. Pratt & Whitney slotting machine. Tools—Holding fixture; special tools.
Operation 12.—Hand work.

OPERATIONS ON THE FIRING-MECHANISM HOUSING KEY

Operation 0.—Heat-treat bars.
Operation 1.—Form-mill top side. Machine—No. 24 Osterlein plain-milling machine.
Operation 2.—Straddle-mill end. Machine—No. 24 Osterlein plain-milling machine.
Operation 3.—Form-mill bottom side. Machine—No. 24 Osterlein plain-milling machine.
Operation 4.—Saw to length. Machine—No. 24 Osterlein plain-milling machine.
Operation 5.—Drill, counterbore and countersink hole. Machine—12-in. Henry & Wright drill.
Operation 6.—Mill slot for spring. Machine—No. 2 Becker vertical milling machine.
Operation 7.—Grind sides. Machine—No. 2 Brown & Sharpe surface-grinding machine.
Operation 8.—Turn 1.279 in. and 1.474 in. radii. Machine—15-in. Crawford lathe.
Operation 9.—Bench work.

The operating lever, Fig. 128, is machined from a drop-forging. There are two spindle arms on the opposite ends, one of which is a hinge pin and the other is the center spindle for the operating-lever handle. The sequence of operations is as follows:

Operation 0.—Heat-treat forging.
Operation 1.—Rough-turn and center both ends of large shaft. Machine—Le Blond gap lathe.

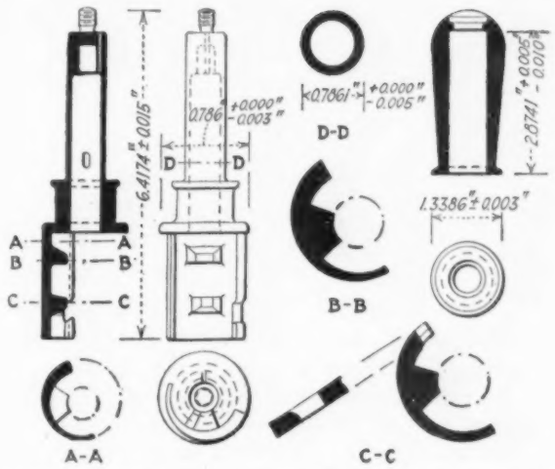
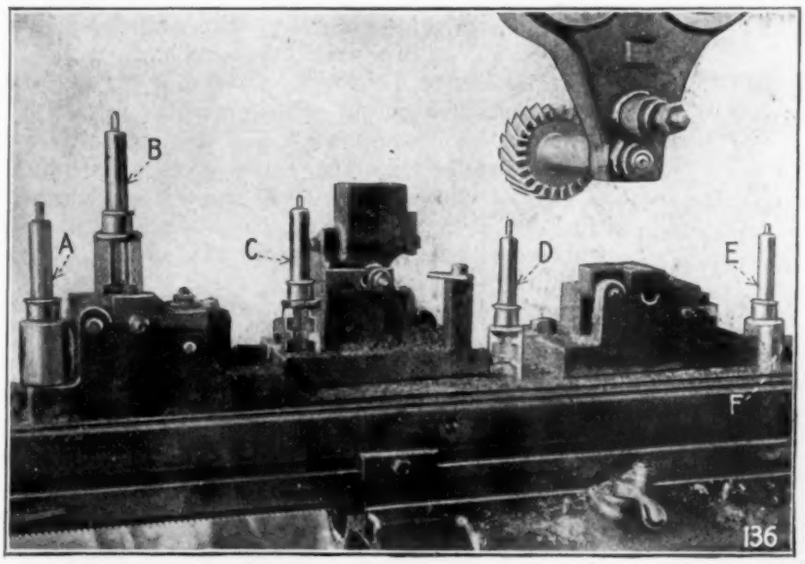
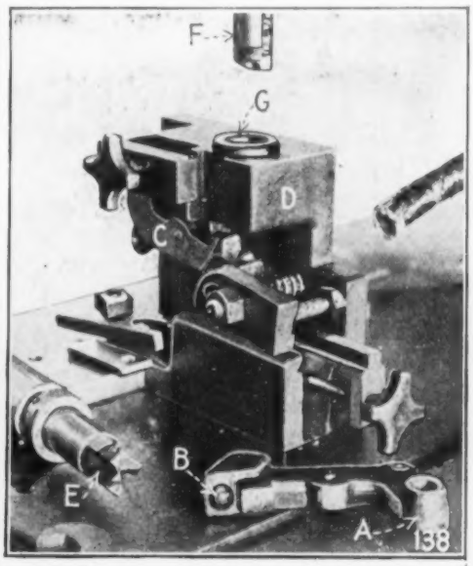
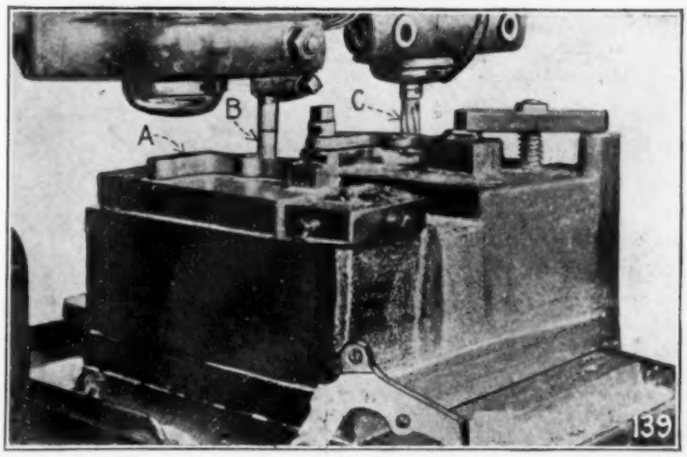


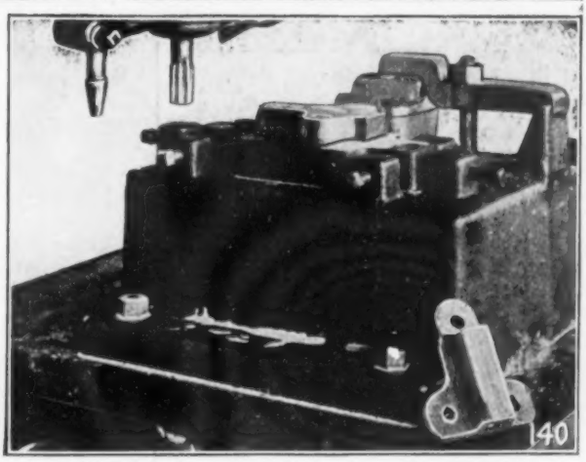
FIG. 135. DETAILS OF OPERATING-LEVER HANDLE

Operation 2.—Rough-mill top face and outside edges. Machine—No. 3 Hendey plain-milling machine. Tools—Gages.
Operation 3.—Rough-mill inside edges. Machine—No. 3 Hendey plain-milling machine. Tools—Gages.
Operation 4.—Rough-mill bottom face. Machine—No. 3 Kempsmith plain-milling machine. Tools—Stub arbors, drills.
Operation 5.—Finish-turn large shaft. Machine—20 in. by 8 ft. Le Blond lathe.
Operation 6.—Rough and finish turn handle shaft. Machine—20 in. by 8 ft. Le Bland lathe.
Operation 7.—Rough-off stock and finish-mill top face and all edges. Machine—No. 5C Becker vertical milling machine.
Operation 8.—Finish-mill all surfaces on bottom face, including









FIGS. 136, 138, 139 AND 140. MACHINE OPERATIONS ON OTHER PARTS

Fig. 136—Milling fixture for operating-lever handle. Fig. 138—Hollow-milling the striking point on the hammer. Fig. 139—Profiling the hammer. Fig. 140—Profiling outside edge of lock-bolt housing

hollow-milling for hub. Machine—No. 2 Cincinnati plain-milling machine; model B Becker vertical milling machine. Tools—Gage, special collet.

Operation 8A.—Form-mill handle-shaft end. Machine—No. 2 Cincinnati plain-milling machine. Tools—End mill, centers.

Operation 9.—Drill and tap all holes. Machine—12-in. Henry & Wright drilling machine.

Operation 10.—Mill T-slot. Machine—No. B Becker vertical milling machine.

Operation 11.—Mill dovetail slot for cover. Machine—No. B Becker vertical milling machine. Tools—Gage.

Operation 12—Broach slotted hole. Machine—No. 3 La Pointe broaching machine.

Operation 13.—Drill and broach small hole in handle shaft. Machine—12-in. Henry & Wright drill. Tools—Gage, drill, fixture, broaches.

Operation 14.—Bench work.

Fixtures for Machining the Operating Lever

There is a large amount of stock on the back edge of the lower forging which is roughed off in a shaping machine. The fixture used for milling the top face and edges is shown in Fig. 129.

The next operation is conducted on two separate machine tools. Fig. 130 shows the method of holding the piece during the milling cut. Hollow-milling the hub is an ordinary drilling-machine operation and needs no description.

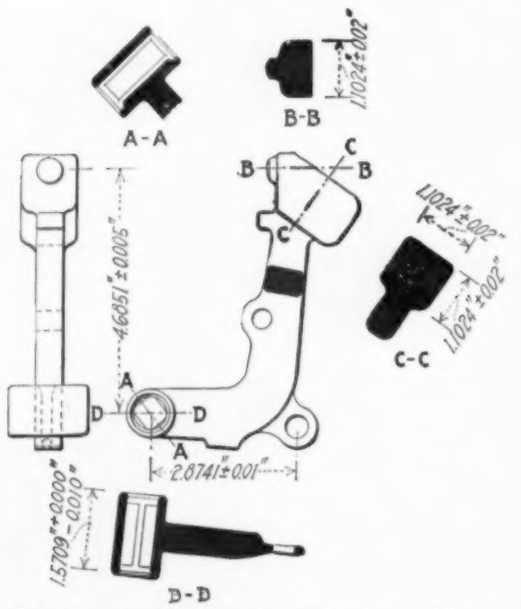


FIG. 137. DETAILS OF PERCUSSION HAMMER

The jig used for the drilling operation, Fig. 131, locates the work by slipping the hinge-pin end into a hardened bushing, as indicated at *A*. An auxiliary jig *B* is placed on the shaft end while drilling the holes in this portion.

The fixture shown in Fig. 132 is used in milling the T-slot on the bottom. This slot contains the arm for tripping the latch during the opening and closing of the breech. The part *A*, which is hinged, is turned over to the left and used as a profile gage for a portion of this cut; it is also held between the lugs *B* for gaging a cut on the opposite side of the slot.

Other Breech-Mechanism Parts

One of the operations on the operating-lever latch, Fig. 133, is shown in Fig. 134. The fixture shown is pivoted about a center pin *A*, and is used for milling the taper on each end of the latch. In use the fixture is tilted up in one direction, and after completing this cut the angle of tilt is reversed for milling the taper on the opposite end. The sequence of operations on the operating-lever latch piece follows:

Operation 1.—Mill and hollow-mill two sides. Machine—No. 4B Becker vertical milling machine. Tools—Hollow shank mills, blades; end mills.

Operation 2.—Mill latch side. Machine—No. 3B Becker vertical milling machine. Tools—End mills.

Operation 3.—Finish-mill side opposite latch. Machine—No. 3B Becker vertical milling machine. Tools—End mills.

Operation 4.—Finish-mill side opposite latch. Machine—No. 2 Cincinnati plain-milling machine. Tools—Gages, milling fixtures.

Operation 4A.—Bench work.

Operation 5.—Casecharden.

Operation 5A.—Polish.

Operation 6.—Grind. Machine—No. 2 Brown & Sharpe grinding machine.

The Operating Lever Handle

The operating-lever handle, Fig. 135, passes through a series of milling operations to shape out the hollow part of its base. Previous to these milling operations its exterior has been finished. Several of the fixtures used are mounted on the milling-machine table, Fig. 136. The piece is shown at *A*, and the first cut *B* removes half of the large end, exposing the bore. Succeeding cuts shown at *C*, *D*, *E* and *F*, complete the series.

The sequence of operations on the operating-lever handle are as follows:

Operation 1.—Drill, ream and face 0.67 in., 0.63 in., 0.354 in. holes. Machine—Foster turret lathe. Straight-shank counterbore, ring gage, two-step hand reamers, pilot reamers, plug gages, pilot bushing.

Operation 2.—Center small end. Machine—Foster turret lathe.

Operation 3.—Rough-turn small end. Machine—16 in. by 6 ft. Prentice lathe. Tools—Snap gages go and no-go, collets, stub-nut arbors.

Operation 4.—Rough large end and finish-turn all over; thread and face to length. Machine—16 in. by 6 ft. Prentice lathe.

Operation 5.—Mill half section of large end. Machine—No. 1½ Milwaukee plain-milling machine.

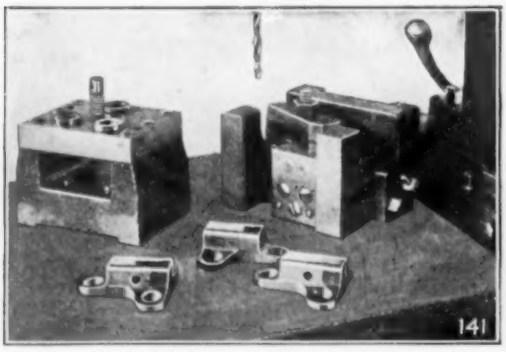
Operation 6.—Mill to form large end. Machine—No. 1½ Milwaukee plain-milling machine.

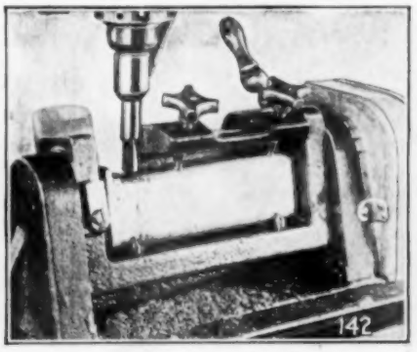
Operation 7.—Mill latch slot on large end. Machine—No. 1½ Milwaukee plain-milling machine.

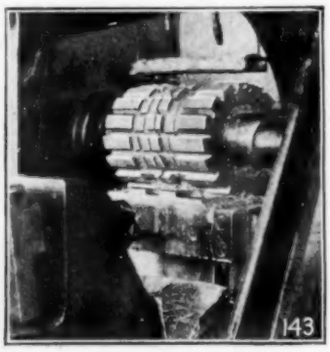
Operation 7A.—Mill clearance cut. Machine—No. 2 Becker vertical milling machine. Interlocking centers, stub arbors.

Operation 8.—Shape out clearance of sectors. Machine—10-in. Pratt & Whitney profiling machine. Tools—Gages.

Operation 9.—Drill all holes. Machine—Henry & Wright drilling machine.







FIGS. 141 TO 143. FINAL DRILLING AND MILLING OPERATIONS

Fig. 141—Drilling jigs for lock-bolt housing. Fig. 142—Rotating fixture for milling breech key. Fig. 143—Milling tongues on counterweight

Operation 10.—Finish-broach slot. Arbor press.
Operation 11.—Turn large end eccentric. Machine—16 in. by 6 ft. Prentice lathe.
Operation 12.—Bench work.
Operation 13.—Caseharden.
Operation 14.—Polish.

THE PERCUSSION-HAMMER PART

The percussion hammer, Fig. 137, is machined from a drop-forging and has considerable excess stock which must be removed. One of the forgings shows in the foreground of Fig. 138 at *A*.

The operation here illustrated is hollow-milling the striking point *B* of the hammer. As will be seen by the piece *C* in the jig *D* this cut is made after the side-milling operations are completed. The roughing work is done with the three-lipped hollow mill *E* and the finishing cut is made with the cutter *F* shown in the spindle of the machine. Both cutters are guided by the bushing *G*.

The face and back are profiled as shown in Fig. 139. The hardened plate *A* acts as a guide for the former pin *B*, while the milling cutter *C* is finishing the edges. This cut is followed by another using a concave cutter to round the edges. The sequence of operations is as follows:

Operation 1.—Straddle-mill ends of hub and sides of head. Machine—No. 2B Milwaukee plain-milling machine.
Operation 2.—Drill all holes and conterbore holes in hub. Machine—Henry & Wright drilling machine.
Operation 3.—Broach hole for shaft. Machine—No. 3 La Pointe broaching machine.
Operation 4.—Face and turn hub and reface sides of head. Machine—18 in. by 8 ft. Mueller lathe.
Operation 5.—Face both sides of web from hub to head. Machine—18 in. by 8 ft. Mueller lathe.
Operation 6.—Hollow-mill striking point. Machine—Henry & Wright drilling machine.
Operation 7.—Mill face and back of web to profile. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 8.—Countersink holes and round edges. Machine—Henry & Wright drilling machine.
Operation 9.—Hand work.
Operation 10.—Caseharden.
Operation 11.—Polish.

PERCUSSION-HAMMER OPERATING SHAFT

Operation 0.—Heat-treat forging.
Operation 1.—Center. Machine—Saxer-Creeder-Speed lathe.
Operation 2.—Turn all diameters to a size, face and thread. Machine—17 in. by 6 ft. Le Blond lathe.
Operation 3.—Form-mill radius on boss and mill sides of crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 4.—Mill stock on radius of crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 5.—Mill flat on boss on crank. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 5A.—Grind to sizes. Machine—No. 3 Modern universal grinding machine.
Operation 6.—Mill flats on hammer shaft bearing and collar surface. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 7.—Mill safety-plunger cut. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 8.—Remove centers and face to length.

PERCUSSION-HAMMER OPERATING-SHAFT HOUSING

Operation 0.—Heat-treat forging.
Operation 1.—Center. Machine—Pratt & Whitney centering machine.
Operation 2.—Turn spots on each end for collet chuck and steadyrest. Rough-face to length. Machine—16 in. by 6 ft. Crawford lathe.
Operation 3.—Drill, ream and counterbore hammer-shaft bearing. Machine—15 in. by 6 ft. Crawford lathe.
Operation 4.—Re-turn spots on end to a dimension. Machine—16 in. by 6 ft. Crawford lathe.
Operation 5.—Rough-form, mill dovetail faces. Machine—No. 3B Milwaukee milling machine.
Operation 6.—Finish mill dovetail section. Machine—No. 3B Milwaukee milling machine.
Operation 7.—Hand-finish dovetail section to fit templet.
Operation 8.—Form-mill top side to form outside thickness and bottom edge to greatest width. Machine—No. 2B Milwaukee milling machine.
Operation 9.—Mill bottom side to form end radius. Machine—No. 2B Milwaukee milling machine.
Operation 10.—Mill slot for hammer and mill ends to length. Machine—No. 2B Milwaukee milling machine.
Operation 11.—Mill pad and profile of lug for safety plunger. Machine—No. 14 Pratt & Whitney profiling machine.
Operation 12.—Mill clearance on top. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 13.—Drill, counterbore and countersink all holes. Machine—Henry & Wright drilling machine.
Operation 14.—Shape slot for plunger. Machine—No. 3 Becker vertical milling machine.
Operation 14A.—Mill angle on end. Machine—No. 1½ Milwaukee plain-milling machine.
Operation 15.—Hand-finish.
Operation 16.—Assemble shaft hammer, plunger and spring complete ready to assemble on gun.

The finished outline of the percussion-hammer lock-bolt housing is obtained by a profile-milling operation, Fig. 140. Some of the drilling jigs used are shown in Fig. 141.

PERCUSSION-HAMMER LOCK-BOLT HOUSING

Operation 1.—Mill flat surface. Machine—No. 24 Osterlein plain-milling machine.
Operation 2.—Drill holes for fastening screws and hole for broach. Machine—two-spindle Henry & Wright drilling machine.
Operation 3.—Form-mill all outside surfaces lengthwise of piece. Machine No. 24 Osterlein plain-milling machine.
Operation 4.—Form-mill all outside surface crosswise. Machine—No. 24 Osterlein plain-milling machine.
Operation 5.—Mill angle cut on top side. Machine—No. 24 Osterlein plain-milling machine.
Operation 6.—Profile outside edges. Machine—No. 12 Pratt & Whitney profiling machine.
Operation 7.—Broach square holes. Machine—No. 3 La Pointe broaching machine.
Operation 8.—Countersink holes for holding screws, drill and tap holes for stop screw. Machine—Henry & Wright drilling machine.
Operation 9.—Hand-finish all over.
Operation 10.—Assemble with bolt and spring complete ready to assemble on gun.

HOWITZER BRIDLE

Operation 0.—Heat-treat forging.
Operation 1.—Shape bottom. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 2.—Shape two sides to a dimension. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 3.—Mill key slot—Auto-spline machine.
Operation 4.—Broach. Machine—No. 3 La Pointe broaching machine.
Operation 4A.—Shape square end. Machine—24-in. Gould & Eberhardt shaping machine.
Operation 5.—Face and turn boss on top. Machine—18 in. by 8 ft. Reed lathe.
Operation 6.—Drill, ream and counterbore. Machine—Fosdick radical drilling machine.
Operation 7A.—Grind all flat surfaces. Machine—Blanchard vertical grinding machine.
Operation 7B.—Bench work.
Operation 7C.—Inspection A. B. S. and Government.
Operation 8.—Fit to gun. Lay out angle surface and measure side surfaces.
Operation 9.—Shape angle surface.

THE BREECH KEY

For the breech leg a rotating milling fixture, Fig. 142, is used for finishing the end next to the shoulder lug with an end mill.

The sequence of operations is as follows:

Operation 0.—Heat-treat forging.
Operation 1.—Grind two sides. Machine—Blanchard vertical surface-grinding machine.
Operation 2.—Form-mill two edges and top of lug. Rough and finish cuts. Machine—No. 2B Milwaukee plain-milling machine.
Operation 3.—Mill both ends to length. Machine—No. 2B Milwaukee plain-milling machine.
Operation 4.—Finish-mill lug. Machine—No. 3H Becker profiling machine.
Operation 5.—Form-mill bevel on end. Machine—No. 2B Milwaukee plain-milling machine.
Operation 6.—Mill radius on lug end. Machine—No. 2B Milwaukee plain-milling machine.
Operation 7.—Drill and tap hole. Mill locking-screw hole. Machine—Henry & Wright drilling machine.

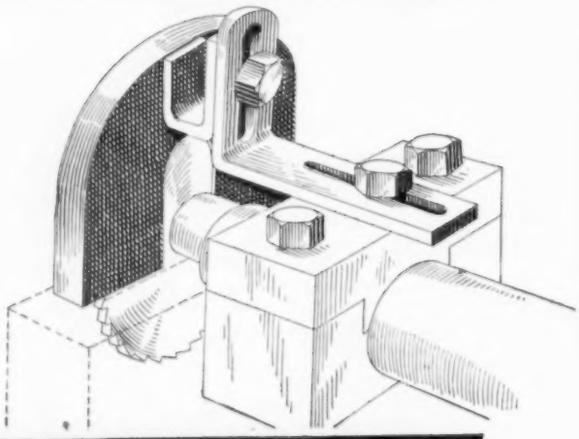
THE COUNTERWEIGHT

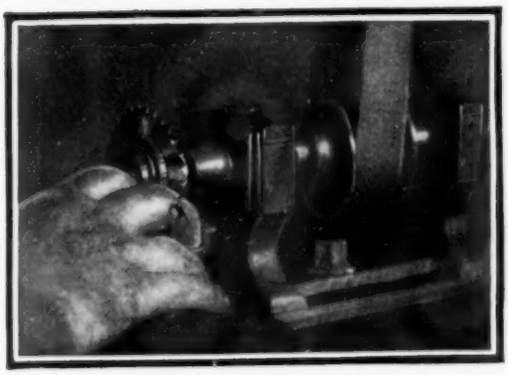
A counterweight serves to balance the howitzer. It is a cast-steel block milled on all surfaces for a finish. One of the milling operations which produces the tongues on its face for holding it in correct position on the gun body is illustrated in Fig. 143. The sequence of operations is as follows:

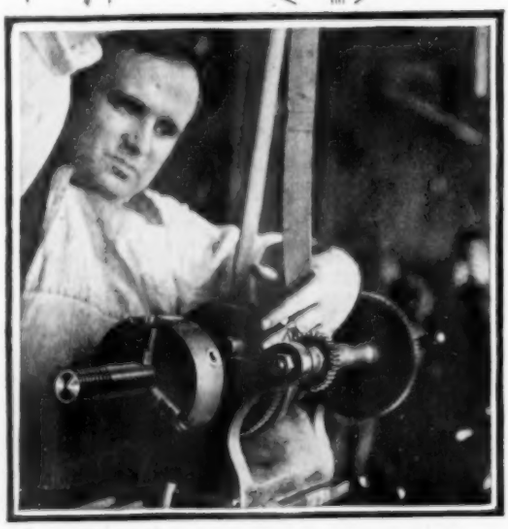
Operation 1.—Face top side. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 2.—Face sides and form radii. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 3.—Face ends. Machine—20-in. Gould & Eberhardt shaping machine.
Operation 4.—Form-mill bottom side. Machine—No. 3B Milwaukee plain-milling machine.
Operation 5.—Form-mill large radius. Machine—No. 3B Milwaukee plain-milling machine.
Operation 5A.—Form-mill radius on edges. Machine—No. 4 Becker milling machine.
Operation 6.—Drill, counterbore and ream soles for holding bolts and sight plates. Machine—Fosdick radial drilling machine.
Operation 7.—Drill, counterbore and tap all holes for lifting eye. Machine—Fosdick radial drilling machine.
Operation 8.—Drill and tap holes for lifting eye-locking screws. Machine—Fosdick radial drilling machine.

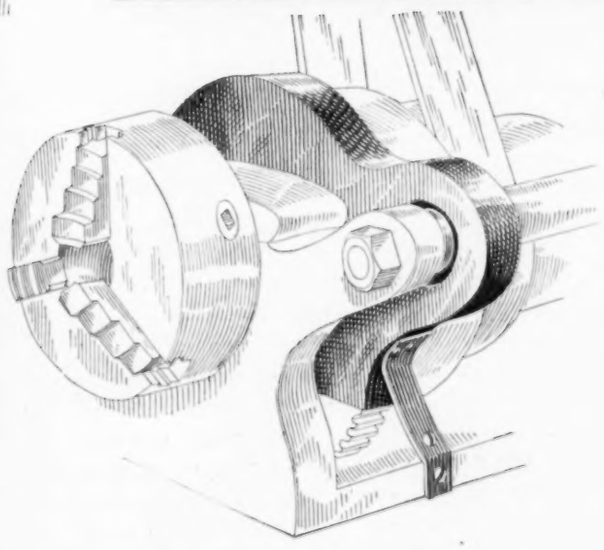
CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas









Extracts From Chordal's Letters

When the backwoods machine shops were primitive affairs the old-time machinists were put to their wits' end to devise ways and means to get out the work, and in the days when the sawmill engine was also a primitive affair and had to stand all sorts of abuse the engineer had to be a genius to keep it running. Cylinders wore terribly from the old hemp piston packing, and if the packing was set up tight enough to stop the leakage of steam the engine would run hard and would not deliver power enough to run the mill. Taking off a cylinder and carting it a hundred miles through the woods to a machine shop to have it rebored was an expensive undertaking.

Mr. EDITOR:

* * * When I was a kid I worked for Porter Holcomb. Port, and a millwright by the name of Thompson owned the shop, which was a small affair working probably 10 men altogether. Port was not a machinist, but claimed to have been a molder. From my experience with him I will say that he was the best all-around machinist it has ever been my good fortune to come across. He ran the machine shop, which had two or three lathes and a drill press, and there was no sort of a job he would not tackle, and not only that but he would tackle it successfully.

* * * The time was just following the Civil War and Holcomb, Thompson & Co.'s shop was out in the wilds 125 miles from a railroad, and the country round about had been pretty well devastated by the armies, and the shop had a golden harvest in making general repairs and rehabilitations of the hundreds of small sawmills and grist mills scattered about the region within a hundred miles of the shop.

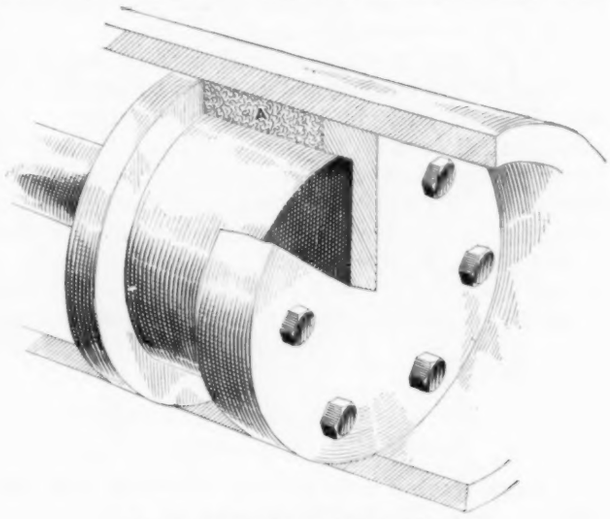


FIG. 1. A HEMP-PACKED PISTON

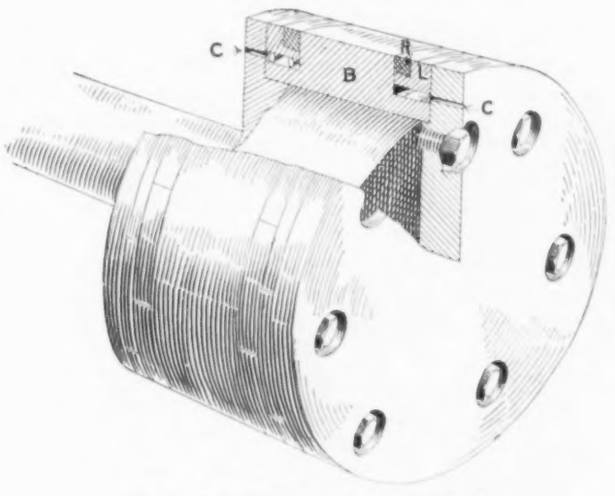


FIG. 2. DUNBAR PISTON PACKING

* * * Some hayseed would come in from the woods and start negotiations for the repair of his sawmill, about which there would be very little left when the war was over. He would bring some of the traps from the engine and from the mill and Porter would make him an estimate on what it would cost, and it was enough, to replace missing parts or to mend broken parts.

* * * The sawmill man, however, would be of the opinion that the cylinder of the engine was all right and that the thing could be got to run by supplying some missing bolts and a valve stem, and some of the screws that held the cylinder heads on, and some of the screws that held the steam-chest cover on, and some of the wrists of the rocker, and part of the eccentric rod, and the bolts of the eccentric strap, and the setscrews of the crosshead, and one of the strap ends of the connecting-rod, and a lot of other things about the engine. But the sawmill man's mind would be centered on that cylinder because it seemed to him to be complete. It had the two cylinder heads on minus a few bolts, and his presumption was that the piston was all right because it was closed up in the cylinder.

* * * And then it occurred to the sawmill man that even four years ago, when the mill went out of commission, there had been trouble with the piston. It would either work too hard and make a lot of noise rubbing in the cylinder or it would leak a lot of steam so that the engine would not give power enough.

* * * The pistons of these engines were, as a general thing, packed with hemp like Fig. 1. The hemp packing *A* would be soaked in oil and then driven in around the body of the piston with a drift and a sledge, the follower being absent, after which the follower would be put on and screwed up to compress the packing, and after awhile, when the thing began to leak too much, then the cylinder would be opened and the follower would be tightened up some more.

* * * There was lots of friction in this kind of packing and it wore the cylinder terribly, but the sawmill man, seeking to get his mill into running order again, would hesitate a long time about paying Port Holcomb a hundred dollars to rebore the cylinder, and furthermore he believed the cylinder was all right anyhow and he didn't want to go to the trouble of unbolting it from the bedplate and hauling it a hundred miles to the shop. Wasn't there some kind of packing that would be all right in this cylinder?

* * * Now here is where Porter Holcomb shone, for he was ready to take the sawmill man's order for Dunbar packing, especially on Port's recommendation that it would accommodate itself to a worn cylinder. And Port would get out this Dunbar packing, even if he was only a molder. I have turned out lots of Dunbar packings myself and always look at it as a pretty fine job of lathe work, but it had no terrors for Port.

* * * I suppose every man who has worked in a railroad shop knows all about Dunbar piston packing,

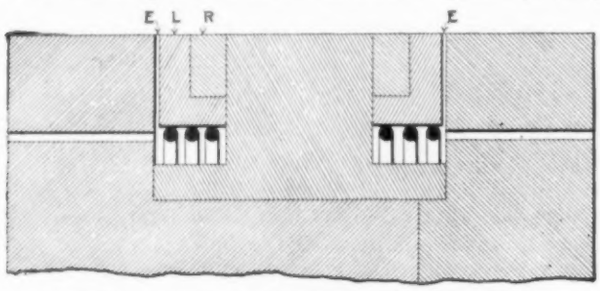


FIG. 3. CLOSE VIEW OF DUNBAR PACKING

but I will take occasion to explain to the uninitiated that it is a metallic packing composed of a lot of segments pressed out to the cylinder by steam pressure underneath the segments, the piston being provided with a set of the rings at each end, one ring to take steam pressure while the piston goes in one direction and the other ring to take steam pressure while the piston goes in the other direction.

Here, in Fig. 2, you have a general picture of the thing with its two rings, each ring composed of a pair of rings sawed up into segments breaking joint. *B* indicates the junk ring with the packing rings at each side of it. Each packing ring is composed of an *L*-ring and an *R*-ring. Rings of spring wire are disposed within the packing rings to keep them out to the cylinder, the main packing effect being produced by steam let inside the rings through the small holes *C*.

* * * Fig. 3 shows the packing full size, and Fig. 4 shows a pair of the *L* and *R* segments. One of the joints straddles pin *D* to keep the segments in proper order, and the backs of the *L* segments are provided with grooves *E* to let the steam behind the packing so as to press the faces of the *L* and *R* rings up against the junk ring.

* * * This description of Dunbar packing is an old story for engine men, but I am particularizing the description for the purpose of showing how Port Holcomb would master the job. He would give the sawmill man a piece of wire and explain to him how he was to cut off that wire and file its ends so that it would rub exactly the bore of his cylinder just inwardly beyond the counterbore. And the sawmill man would ride away to his mill and would come back with the old piston and its rod and with the wire, which he said showed the diameter of his cylinder to a gnat's heel. And then Port would proceed to make the new packing.

* * * Anyone who has had experience with Dunbar packing knows that you not only have to have things the right size but that there is considerable skill involved in assembling the parts in the cylinder. You put in the spider, but not the junk ring or the follower, and then you carefully build up the first packing ring and put the wire springs inside of it. Then you slide the junk ring into place, after which you proceed to build up the segments of the other packing ring and put the wire springs inside. Then you bolt the follower to place and the job is done.

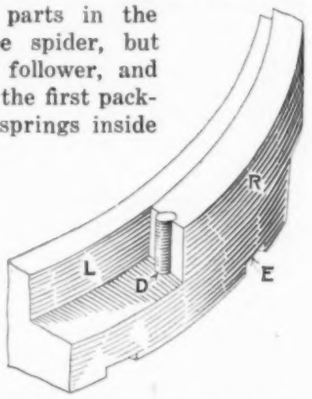


FIG. 4. L AND R SEGMENTS

* * * Now it would be utterly beyond the original capacity of the sawmill man to build up one of these pistons, but Porter Holcomb would save him the trouble. He would have a tinner make a tin hoop which would go around the piston, and Port would carefully surround it with bags and send the sawmill man home with instructions to poke the piston rod into the cylinder, letting the tin hoop into the counterbore, whereupon the piston was to be slid out of the hoop and completely into the cylinder.

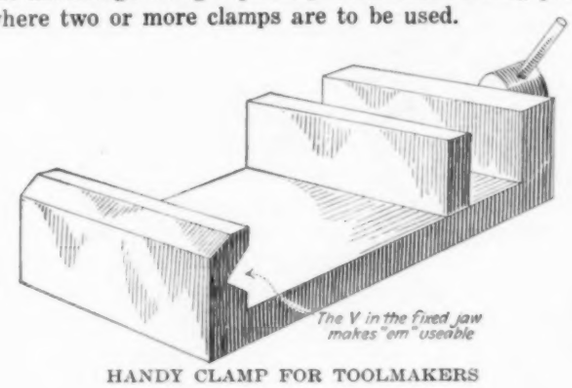
* * * Port furnished a number of Dunbar piston packings in this manner, and so far as I know they did their business all right. I remember the case of one chap who fell down on the job and got the tin hoop off of the piston before he got the piston into the cylinder, the result being that the whole of the packing fell into pieces and made a mess like a mouse's nest. The chap came back to the shop with the pieces, and he had to come about fifty miles, and thoroughly mastered the manner in which this packing was to be put together.

Very respectfully, CHORDAL.

Kink in Toolmaker's Clamps

BY FRED W. STALKER

A trouble-saving little kink in connection with toolmaker's clamps is shown in the sketch. The V in the fixed jam enables one to line up round work readily, the advantage being especially noticeable on long pieces where two or more clamps are to be used.



HANDY CLAMP FOR TOOLMAKERS

Disability Under the Compensation Acts—III

BY CHESLA C. SHERLOCK

The meaning of permanent total disability is a fertile cause of legal controversy. The question as to whether a workman shall receive total-disability compensation for the loss of a second member is difficult to answer, particularly when the losses occurred while he was working for different employers. The spirit of the Compensation Acts must be considered as well as the bare statement of the statutes, and also the fact that the burden on the employer is only temporary, eventually being shifted to the consumer.

DISABILITY is in one sense always permanent, being divided into temporary, partial and total. We have already considered the first two classes and will now consider disability in the sense that it is permanent and total.

To say that a disability is permanent and total is to infer that the workman has lost 100 per cent. of his efficiency as a worker. It must be kept in mind that this complete loss of efficiency is in relation to his employment at the time of injury and not in relation to himself as an individual.

In considering other classes of disability we have found that earning power may or may not be the controlling factor in determining the workman's right to compensation. This is likewise true in the case of permanent total disability. It simply means that the workman has been deprived of his ability to earn a living in that particular employment which he was engaged at the time of the injury. As an individual he may not in fact be actually deprived of his usefulness to earn money in other callings.

Too often confusion arises in cases of permanent total disability, employers being of the opinion that no workman is entitled to compensation on this basis unless he is unable to earn any portion of his livelihood in the future.

Permanent Total Disability

Permanent total disability is a condition which necessarily must be proved by the facts in the case, although it may in many instances arise by presumption of the law itself.

Thus the loss of both eyes is presumed in most of the states to amount to permanent total disability, as well as the loss of both hands, both feet, both arms, both legs, etc. It should be kept in mind that this loss must ordinarily be sustained as the result of the same accident and not as the result of separate accidents.

In this connection some of the hardest fought principles under the compensation acts are brought about. Suppose a machinist while working for one employer loses one eye. That employer pays him compensation accordingly, and at a later date, while working for another employer, the workman sustains another accident which deprives him of the sight of the other eye. The question arises as to whether this workman is entitled to receive compensation for permanent total disability from the second employer, or merely for the loss of one eye, which is generally rated as permanent partial disability.

This question of the loss of the second eye has probably caused more contention in the courts than any other disability question. The courts are slightly divided, some holding that the workman is entitled to permanent total disability benefits, while the majority of the courts hold that he is entitled only to compensation for the loss of one eye.

In California the commission considered one of the cases and came to the conclusion that the employer causing the loss of the second eye was liable not for both eyes, but merely for one. The commission felt that if it were to make a ruling to the effect that the loss of the second eye would entitle a workman to compensation as for the loss of both eyes it would work an injustice on one-eyed workmen within the state, the idea being that employers would refuse to employ such workmen in the future if the loss of the second eye was to impose permanent total disability liability upon them.

Massachusetts Supreme Court Decision

In Massachusetts the Supreme Court adopted the contrary view, holding that if a one-eyed workman was able to do the work of an able-bodied man that he "had the capacity which enabled him to do the work for which he was hired," and since the loss of the eye terminated that degree of capacity then the employer, having been responsible in the spirit of the law, should bear the loss.

This latter opinion seems to be founded on justice when the condition of the workman is considered in view of the evident spirit of the compensation system. True it is that an unequal burden is imposed on the employer causing the loss of the second eye, but it is the evident intention of the compensation acts to award permanent total-disability benefits to a man who loses both eyes in industrial labor. The mere fact that he is unfortunate enough to lose his eyes in separate accidents should not operate to deprive him of the benefits intended to be conferred upon him.

The burden on the employer is of course only temporary, as it is the theory of the compensation acts that the costs of industrial losses under the system shall be borne as a part of the cost of production and ultimately fall on the ultimate consumer, as they do.

In some instances this liability is directly imposed on the employer causing the second loss of a member by the statute itself, and as the situation becomes more and more noticeable it is safe to say that the liability will be imposed in most of the states.

In Iowa a ruling was handed down to the effect that a workman having only one eye and losing it was entitled to more compensation than a workman with two good eyes, but that he was not entitled to as much as he would have received had the eyes both been lost in a single accident.

Michigan sustains the California view, holding that if a workman sustains an injury which, considered in view of a previous injury, amount to permanent total dis-

ability but is partial itself the employer is liable only for the payment of partial-disability compensation.

West Virginia, however, agrees with the Massachusetts view, the commission of the former state granting life compensation to a workman losing the second member.

In New York the court followed the Massachusetts decision. The case was where a workman lost his second hand. The court said that there was a presumption that he had been forced to work at a reduced earning capacity because of the loss of the first hand and that to say that he was entitled only to the compensation which a man with two hands would receive for the loss of his first hand would be to place him at a double disadvantage and that he would only get about half as much compensation for an injury which was doubly important to him.

The legislature, however, after this decision, amended the New York law so that the compensation payable for a second injury is limited only to immediate effects and not to combined effects. The inference is that New York would allow a workman suffering the loss of a second member only compensation as suffering a permanent partial disability and not as suffering a total disability.

Effect of Intervening Causes

The permanent total disability can arise only from the consequences of the original injury and not from the consequences of any intervening act either on the part of the workman or of the physician who treats his injuries. In Kansas it was shown that a workman's total disability was the result of the malpractice of the physician furnished the workman by the employer and not the result of the accident. The court held that the workman was not entitled to recover compensation for permanent total disability from the employer as the disability was not the result of the accident, but the result of an intervening cause.

It is extremely doubtful, however, as to whether this decision would obtain, so far as it related to the physician, in all jurisdictions. The employer is bound by the clause in the acts to furnish competent medical aid, and it is generally held that if he fails to do this that he must be liable to the workman for the damage done. It is clear in either case, however, that the workman's right to maintain an action for damages against the employer for furnishing incompetent medical aid at common law is not impaired in the least by the acts.

The subject of preëxisting condition has already been treated in these columns, but it is worth while to recall some of the provisions stated therein in this connection. If an accident overtakes a workman and causes him to sustain a permanent total disability which he would not have sustained had he been in good physical condition he will be entitled to compensation for permanent total disability without regard to his preëxisting condition. The test of a workman's capacity is this: Was he able to do the work of an able-bodied man? If so then his preëxisting condition cannot be taken into consideration, although it may be so pronounced that only a minor injury would cause complete loss of earning power to him and entitle him to compensation for permanent total disability.

This is the rule practically everywhere, and while the courts have been disposed to draw sharp distinctions in the case of loss of second members and impose liability on employers in many of the states only for permanent partial disability they have not drawn any such distinctions in the case of preëxisting condition.

The New Jersey court, however, overruled the preëxisting condition rule in the case of a workman aged 73 years who had suffered a broken leg. It was shown that because of his age the bones refused to knit and he was actually permanently totally disabled. The court, however, granted him compensation only for the loss of the leg and not for permanent total disability.

If the permanent total disability is due to any fault of the workman himself arising after the accident took place he cannot receive compensation for such wrongful act of his own. This rule is particularly noticeable in cases where the workman refuses to accept the medical aid offered him by the employer, but persists in following his own remedies or in consulting incompetent or "quack" doctors. If such persistency on his part aggravates the original injury to such an extent that it causes permanent total disability the loss will be that of the injured man and not that of the employer.

If an operation will remedy the disability and change it from permanent total to partial total it is the duty of the injured man to submit to such operation if offered by the employer, provided it will not endanger his life. His refusal will entitle him only to compensation for the probable length of time spent in the hospital and then for the partial disability which would result from the operation if successful thereafter. If the operation will restore him completely to his former earning power in his employment he will be entitled, upon refusal to submit, only to such compensation as will cover the probable length of time he would spend in the hospital and in recovering from the operation.

Benefits for Total Disability

The benefits payable for permanent total disability vary in the different states. Some make a flat award based on a percentage of the workman's average wage extending over a period of weeks, generally 400. Others base the payment on the pension system, and others on a flat rate for life.

The average benefit, however, for permanent total disability is for eight years' compensation determined according to the workman's prior wages in his employment. Often this has no reference to the workman's expectancy of life, sometimes being considerably less and sometimes considerably more.

In Wisconsin under the law a workman received compensation for more than six years, although his expectancy at the time of the award was less than four and one-half years. In cases where the workman sustains permanent total disability in his youth his expectancy of life is of course often greater than the period over which compensation is to be paid, unless he lives in a state where the award is for life.

In this connection it is well to note that the expectancy of a workman permanently totally disabled is not ordinarily that of an able-bodied man and the majority of them do not survive their awards. In the case of a loss of both hands, eyes or feet, or where the disability is presumed by law, the workman often survives his compensation benefits.

Where the workman dies before his term of compensation payments are up some interesting questions arise. If death is due to the injury the dependents of the workman, if any, are entitled to death benefits less any compensation already paid. If the death is due to natural causes and is not the result of the original injury the compensation payments will cease on the death of the workman, unless the fixed award for the permanent total disability is held by the court to be a vested right in the estate of the workman. Then the remainder due would be payable to the workman's estate.

The Purpose of Compensation

Where a workman dies leaving no dependents the payments will cease on his death and ordinarily they will not be held to be vested rights in his estate. The purpose of compensation is not indemnity or benefits as under ordinary insurance. It is to share the loss of earning power or efficiency with the workman or his dependents. No beneficiaries are recognized under the compensation acts, unless they be actual or presumed dependents of the deceased.

The question of what is permanent total disability outside of those cases presumed by the law itself which we have already considered is a question of fact to be determined by the facts surrounding each particular case. It is not necessarily a fact to be determined by the jury.

In California a workman came in contact with an electric current and sustained permanent complete disablement of the right arm, shoulder, hand, a spinal deformity, together with complete loss of motion of spine, shoulder, hand, neck, limited motion of the right leg and distortion and lameness in both feet. It was held that he had suffered 100 per cent. permanent disability. And in another California case where a workman had suffered paralysis of the body from the waist down, including both legs, which was permanent, it was held that he had sustained 100 per cent. permanent total disability.

In Connecticut it was shown that a workman had no useful vision for his work but that he could count figures at a distance of two feet. The court refused him compensation for permanent total disability, but allowed it for partial disability.

In Massachusetts a workman suffered the loss of an arm, due to amputation, and on evidence that he was unable to carry on his work and that another operation was necessary to treat extreme sensitiveness of the arm it was held that he was totally incapacitated from work and entitled to compensation upon that basis.

In another case a workman sustained the entire loss of vision in one eye and 95 per cent. loss in the other. The court held that he was entitled to compensation for permanent total disability on a showing that he was unable to carry on his work. This in spite of the fact that the law generally specifically provides for loss of vision in "both eyes" if permanent total-disability benefits are to be paid.

On the whole, disability defines the actual amount of compensation for which an employer is liable after it is found that the accident causing the injury comes within the coverage of the acts. It is the first instance where the practical operation of the law comes into operation after the theoretical liability has been determined.

In our discussion of this subject we have found that there are three great classes of disability:

1. Temporary—where the workman is for the time being unable to carry on his work. It generally dates from the time he is injured until his earning capacity is restored to him. It may be either total or partial, but it is very seldom total, especially when the workman can by reasonable diligence earn a living.

2. Partial—where the workman has not permanently lost his earning power, but has suffered a partial impairment of his efficiency. These disabilities are generally permanent in character, and a workman is entitled to compensation for them according to the schedules without reference to his earning power.

3. Permanent or total—where the workman's earning power in his trade or calling has been completely destroyed. This may arise by presumption of law, as in the case of the loss of two members by the same accident or it may arise from the facts in the case.

A Universal Guard for Milling Machine Cutters

Special Correspondence

The guarding of milling cutters in operation is a difficult problem, owing to the conditions under which such cutters work. In designing a guard for this purpose provision must be made not only for setting and removing the work but for introducing oil or cutting compound in sufficient quantity and for the necessary clearance space for chips. It must be adaptable to all sizes of cutters and all classes of work within the range of the machine, must not interfere with any fixtures that may be used, and must make it practically impossible for the operator's fingers to come in contact with the cutter. In addition to fulfilling all these requirements it is usually desirable, if not essential, that the work at the point of cutting be visible throughout the milling operation.

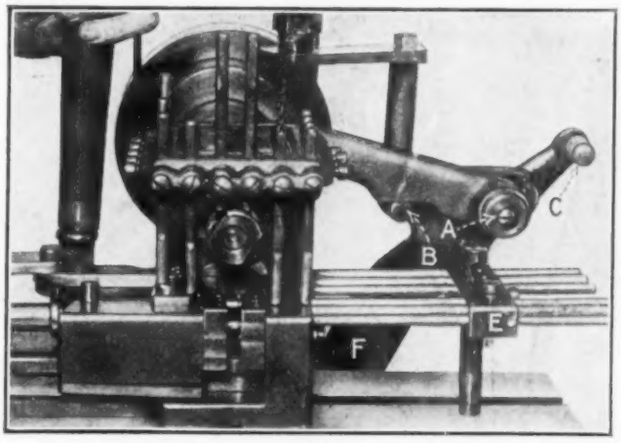


FIG. 1. CUTTER GUARD CLOSED

An interesting guard of the universal type, embodying novel features, is shown in the illustrations. It accomplishes the object set forth above, and it is so constructed as to be adapted to service on any class of milling machine where a safeguard is desired. By

a slight modification in the supporting bracket it may be suited to any size or type of milling machine and the guard may be proportioned for any size or form of cutter. It may be adjusted to accommodate any shape of work within its range and yet close the point of cutting against possibility of fingers or clothing being caught.

Method of Attaching

Figs. 1 and 2 show the guard attached to a hand-milling machine in both the closed and open positions. The supporting arm swings about the stud *A*, the guard being supported at the right height by the pin *B*. To remove it for the purpose of changing cutters it is necessary only to lift or swing the guard about the stud *A* until the arm rests against the pin *C*, where it is held by gravity until the operator is ready to again lower it to the closed position.

From the illustrations it will be seen that the guard consists of a slotted frame carrying a series of small rods which project downward to inclose the cutter and

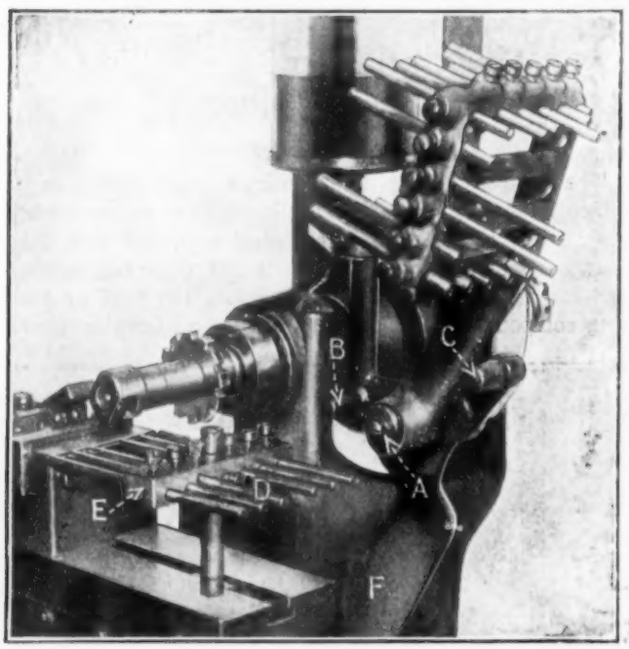


FIG. 2. CUTTER GUARD OPEN

work, the frame being cast integrally with the supporting arm. The rods are ¼ in. in diameter and spaced on ⅝-in. centers, so that the opening between them is but ⅜ in. They may be adjusted vertically to conform to the shape of the work and the fixture in use.

In the size illustrated there are six of these rods on each of the three sides of the guard. The bottom is guarded by a set of rods *D* carried horizontally in a holder *E*, which is fastened in the T-slot of the machine table. Thus the two portions of the guard form a complete fence around the cutter. The horizontal rods under the cutter are set to contact with the back of the vise, leaving no opportunity for the workman to get his fingers in contact with the cutter from this side when loading the fixture.

Notwithstanding the complete inclosure of cutter and work when in operation there is no interference with the setting or removal of the work; the cutting is always under observation and the work is as fully open to lubrication as if it were being done in the customary unguarded manner.

The bracket *F*, which attaches the guard to the milling machine, is so adjusted that the center of the pivot for the swinging arm comes slightly above the cutter arbor, and a slot at the point of attachment allows a certain amount of adjustment for the frame to suit the machine upon which it is used. The bracket also has a projection for attaching an oil cup.

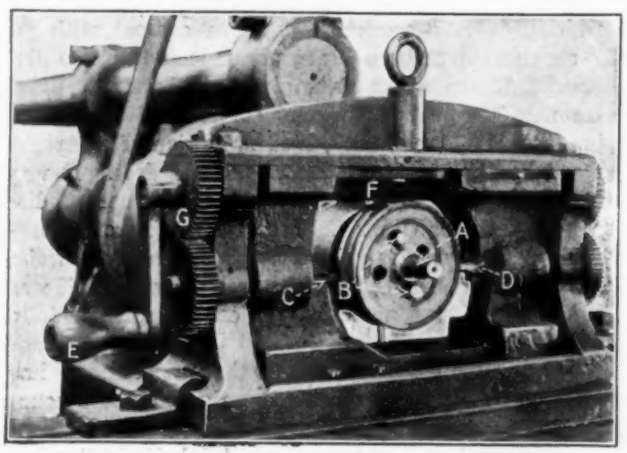
The guard is the invention of J. B. Holden of 14 Gifford St., Syracuse, N. Y.

Fixtures for Turning Grooves in Trolley Wheels

By J. Wright

The economical production of trolley wheels is an important factor in the large electric-railway systems, and the device which is illustrated herewith is one that has been developed by the Chicago Surface Lines to facilitate this work. It is designed to clamp onto the table of a milling machine, and when it is brought into alignment with the spindle the table is locked in position. The work-carrying device is a special head which screws onto the spindle of the machine.

In the illustration a wheel may be seen on the stud *A* which passes through the hole in the hub of the wheel.



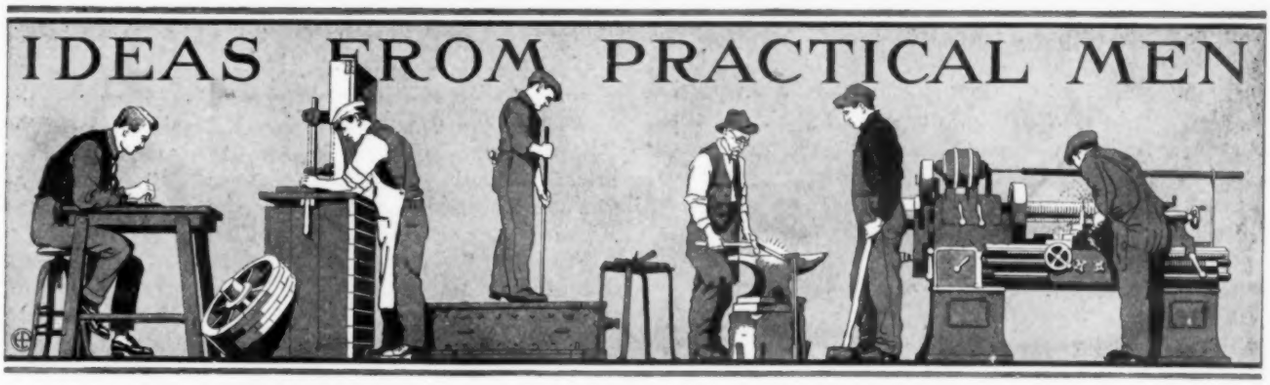
FIXTURE FOR TURNING GROOVES IN TROLLEY WHEELS

A nut screwed on the threaded end of this stud tightens the work firmly in position. Two studs *B* passing through cored holes in the web of the wheel do the driving.

The tool bits *C* and *D* are carried on slides which are mounted on opposite sides of the fixture and are fed to the cut by turning the crank *E*. This turns the shaft *F*, which is geared to right and left hand screws operating their respective slides.

It is an easy matter to adjust the cutting tools to balance the cut, as the operator needs only to move the milling-machine table sufficiently in one direction or the other to accomplish this result. Consequently in sharpening these tools the matter of readjustment in replacing them is a minor consideration.

The fixture is quite heavy and an eyebolt is provided so that a crane may be used for lifting it on and off the machine. With this device the operator is able to turn the grooves of about 55 trolley wheels an hour.



Forming an Electrical Contact Plug

BY OTTO VOGETZER

The plug shown in Fig. 1 is used in conjunction with the rheostat that is shown in Fig. 2 for the purpose of controlling the intensity of light used in a machine for printing motion-picture film. That the reader may understand the function of the plug it will be necessary to go somewhat into detail in reference to the operation of the rheostat.

Under the printed card seen on the face of the rheostat are 18 copper bars insulated from each other and each having 21 holes for receiving the plugs. The cards serve merely as a guide for placing the plugs and are pierced with holes in accordance with the intensities of light required for printing the successive scenes of their corresponding film. Leads from these bars are connected through progressive steps of the resistance coils to the lamp used in the printing machine and thence to one side of the electric circuit, while the other side is connected to the movable brush bar to be seen at the right of the rheostat near the top.

The brush bar is hinged at this point to close across the face of the rheostat, where it is latched in place on the opposite arm of the lever, at the point which is adjacent to the indicating pointer to be seen at the left.

When the brush bar is in the closed position it may be moved downward over the face of the rheostat, contacting successfully with the plugs which have been placed in accordance with the chart. Thus if we wish to print scene No. 1 with light No. 4 and scene No. 2 with light No. 10 we place a plug in the corresponding holes, and so on down until all the scenes in the roll of negative film are provided for. We are then ready to make any required number of copies, the plugs remaining in their respective places until all are finished.

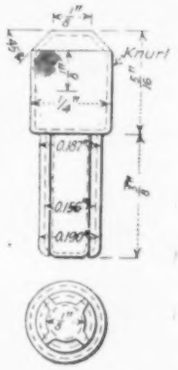
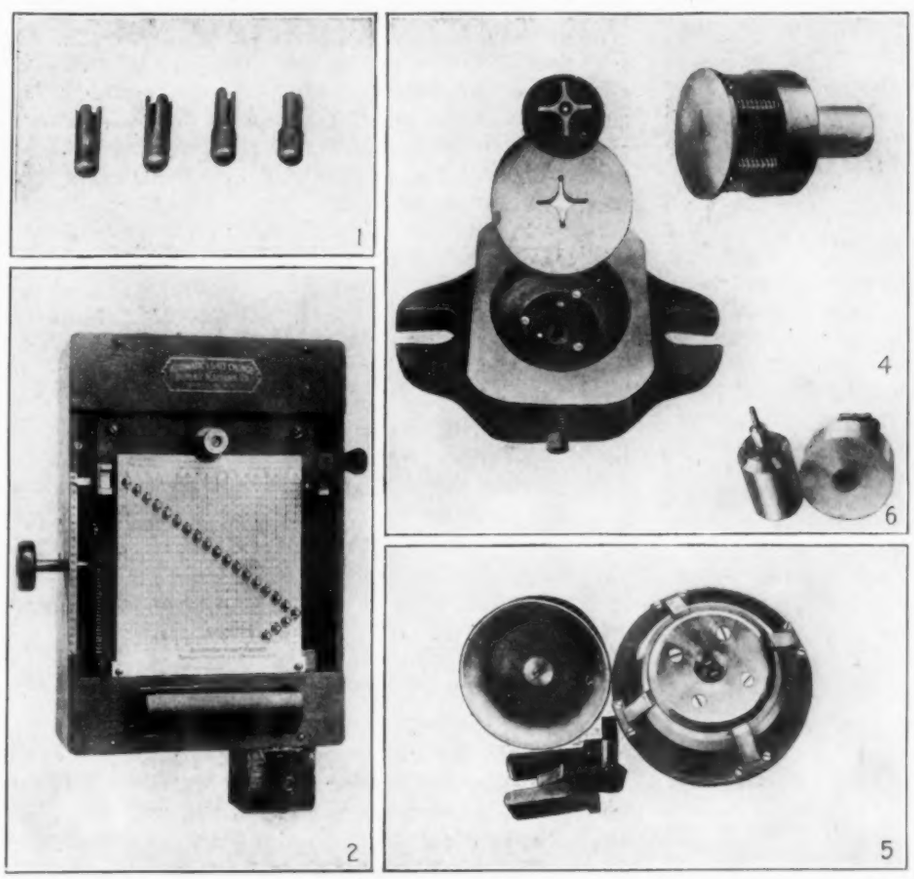


FIG. 3. SECTION ENLARGED

The dropping of the brush bar is controlled by the negative itself and is raised by means of the handwheel on the left after each copy.

From the foregoing it will be seen that the plugs must be easily removed and yet be sufficiently tight to prevent working loose when the brush bar passes from one to the other.

The plugs, a section of which is shown in Fig. 3, are made of 0.016-gage brass in four operations, the first being done with the combination blanking and drawing die



FIGS. 1, 2, 4, 5 AND 6. MAKING A PLUG FOR A RHEOSTAT

Fig. 1—Sequence of operations on plug. Fig. 2—The rheostat showing brush bar open. Fig. 4—The blanking and drawing die. Fig. 5—Tools for closing in and knurling. Fig. 6—Final closing tools

in Fig. 4. As the punch descends into the die a blank is punched out and drawn up by the drawing die which is in the center of the punch.

On the upstroke the shell is ejected by a spring-operated plunger. The blanking die is given very little clearance, which tends to keep the blank central, so that the four spring prongs may draw together evenly.

The second operation consists of knurling the shell, which is accomplished by means of four sliding jaws in the fixture shown in Fig. 5. These jaws are closed in simultaneously by the conical recess in the punch, a mandrel preventing the shell from being crushed.

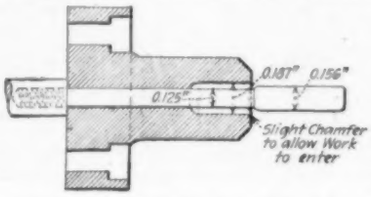


FIG. 7. SECTION OF CLOSING PUNCH

The third operation consists of partly closing in the four prongs. The same fixture is used as for the knurling operation, the knurling jaws being removed and another set is inserted having the same radius as the small end of the plug. The punch carries a mandrel in the center equal in diameter to the inside diameter of the plug. When the punch descends the mandrel enters the shell and the jaws close in. On the upstroke the shell is carried up by the mandrel and is easily stripped off by hand.

For the fourth operation the shell is placed in the die, Fig 6, the bottom of which has the shape of the head of the plug. The punch descends, forming shoulder and closing in the end. The work is ejected from the punch by the spring-operated plunger in the center.

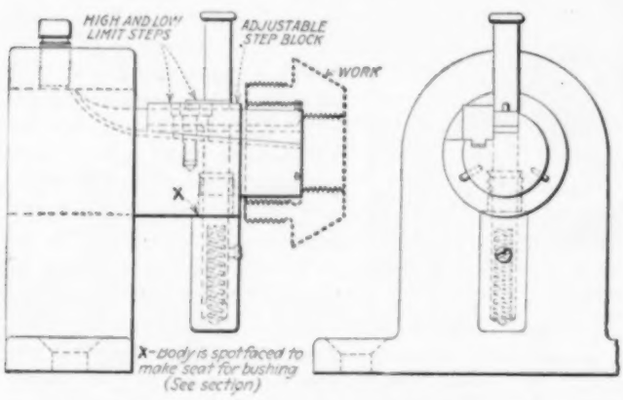
A section of the punch is shown in Fig. 7.

Gaging the Recess at Bottom of A Tapped Hole

BY DANIEL G. MEIKLE

Having had a number of pieces rejected by reason of variation in the diameter of the recess, or undercut, at the bottom of a tapped hole, said recess being merely clearance for the tap, we were obliged to devise some sort of gage which could be used by the women inspectors to keep tabs on this important [?] point.

We considered first an indicating gage to be slipped into the undercut, but as it seemed especially desirable to keep away from all delicate construction this idea was discarded and a special gage as shown in the cut was built.



GAGE FOR TESTING DIAMETER OF UNDERCUT

A sliding piece, provided with a point small enough to enter the undercut, two steps and a finger button, was set into a round block carrying two fixed points, the three points being set at 120 deg. to each other. An adjustable block sliding in a groove on a taper was fastened to the round piece by a screw in a slot in the block.

The points were set by a ring having an inside diameter equal to the high limit of the required recess and one step of the gaging piece ground flush with the block, after which the points were set by another ring equal to the low limit and the other step ground.

In use the gage was held in a cast-iron bracket screwed to the bench. The sliding piece was pushed down by the forefinger of the left hand and the work set over the pins with the right hand. The sliding piece was then released and the spring brought the points into contact. A glance at the steps on the gage showed at once whether the undercut was too large, too small or correct. The operation was very rapid and nothing on the gage was of delicate construction.

Every morning the master ring was slipped onto the pins, and if the pins were worn so the steps did not line up with the block the block was moved up the taper until it was flush and again tightened. The gage was thus always kept perfect without removing it from the bench.

Gaging Devices for Chasers

BY J. B. SMITH

In the manufacture of chasers for use in self-opening die heads it is necessary to hold them to extreme limits of accuracy to insure absolute interchangeability for quick replacement, when the occasion demands. Some of the gaging devices used for the inspection of these at the plant of the Modern Tool Co., Erie, Penn., are shown in the illustrations.

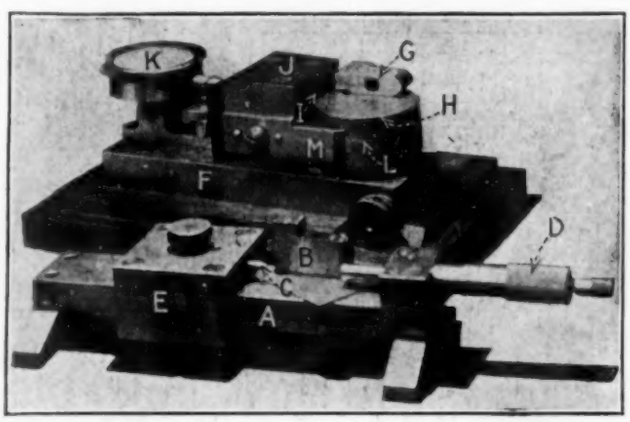


FIG. 1. DEVICES FOR GAGING LENGTHS AND CLEARANCE OF CHASERS

The length is gaged by means of a device shown at *A*, Fig. 1. The length of the blank *B* is measured from the bottom of the thread to the round end opposite. The chaser is therefore stood about in the position indicated in the illustration, but so placed that the cone point *C* on one end of the gage will fit into the root of the thread. A set of chasers is gaged for uniformity by means of the micrometer sleeve *D*. The block *E* is ad-

justable for different lengths of chasers and a reading is taken first from a master block when starting to gage sets of corresponding size.

Chasing the threads is done in a manner to provide clearance for cutting, and this clearance must be a specified amount in a given distance across the thread face. The gage shown at *F*, Fig. 1, determines whether this clearance has been cut correctly.

The chaser *G* is placed in the position shown on the polished top of the circular disk *H*, and pressed tightly against the right-hand face of the block *J*, so that the projecting lug *I* comes in contact with the face of the

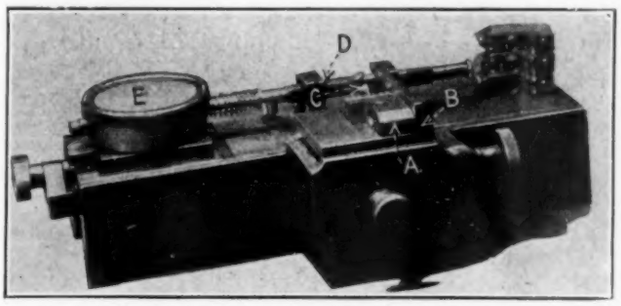


FIG. 2. GAGING RELATIONSHIP OF PIECES OF A SET OF CHASERS

thread. The pressure forces back the lug *I* until the outer corners of the thread come into contact with the face of the block *J*, the movement being gaged in thousandths by the dial gage *K*.

When making this first reading the dial indicator is set to read zero. The block is then turned upside down to bring the other flat face on the table and again pressed against the indicator. The difference between the two readings shows the clearance of the threads.

As this clearance will be variously proportioned to different sizes of chasers as they increase in thickness an adjustment has been provided so that the table *H* may be raised and lowered. Its height is observed from the relation of the line *L* to the scale on the outer end of the projecting arm *M*.

These chasers must also be checked to insure that each set of four has been so made up and consecutively numbered that each chaser is exactly 90 deg. from the preceding one. This is checked by means of the device shown in Fig. 2. The chaser *A* is pressed against the shoulder *B* and the position of the thread located by the pointer *C*, which is provided with a ball end that fits into the thread. The pointer *C* is attached to the rod *D*, which operates the dial gage *E*.

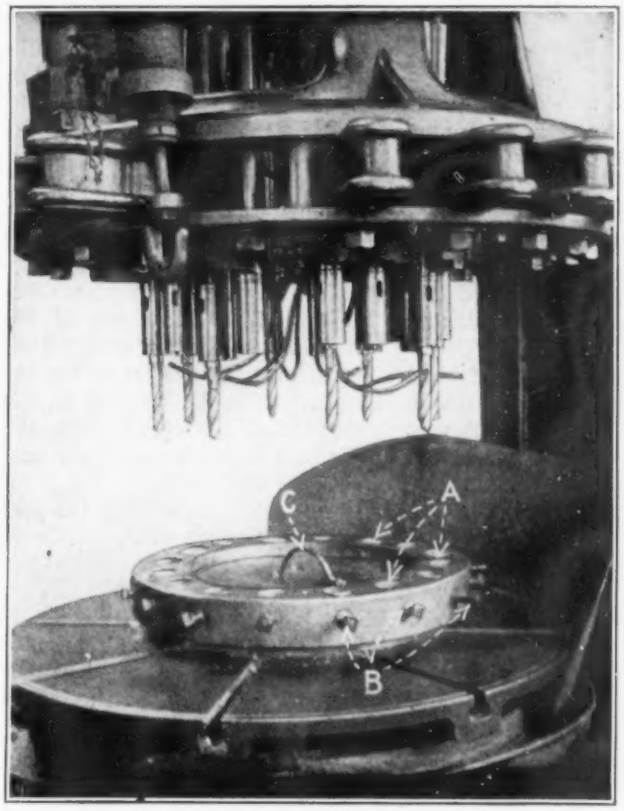
The reading of No. 1 chaser is first set at zero on the dial and the remaining three chasers are then successively gaged in the same manner. A chart which is furnished the operator indicates the thousandth variation which should be found in the successive chasers of each set of any one size.

A Simple Drilling Jig for Bushings

By E. V. Allen

In the Chicago shop of the Northwestern R.R. link bushings are drilled 16 at a time in a multiple-spindle drilling machine.

The jigging device consists of a large cast-iron disk, with holes like *A* in it slightly larger than the bushings. The bushings are slipped into these holes and locked by



A DRILLING JIG FOR BUSHINGS

means of setscrews like those shown at *B*. The handle *C* is provided to lift the jig off the table after the clamping bolts are removed, leaving the table clear for other work.

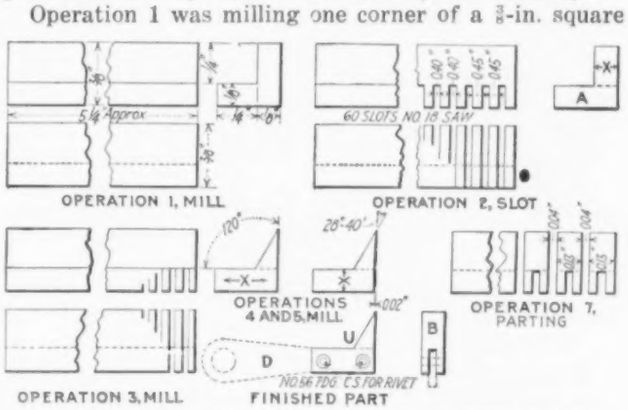
Experimental Production of Actuating Pawl

By Fred W. Stalker

The part here shown was used to actuate a coincident member at regular intervals, the timing of which was to be as accurate as practicable. The cam, or ratchet wheel, which the pawl engaged, was the driving member, turned and milled from No. 12 sheet steel, the teeth being polished before removing the parts from the arbor. The usual practice of leaving the ratchet wheel soft and hardening the pawl was followed.

The method used in machining proved quite satisfactory, leaving nothing to be desired either from a production standpoint or in uniformity and accuracy.

Operation 1 was milling one corner of a $\frac{3}{8}$-in. square



OPERATIONS IN PRODUCTION OF ACTUATING PAWL

cold-rolled blank, as shown in the illustration. The X double arrow indicates the portion held in the milling vise and the direction of the jaw pressure. The length of blank stock was approximate for the number of parts required, covering a possible loss in manipulation.

Operation 2, slotting, was a factor which governed the dimension 0.045 in. This was arbitrary and was selected to provide an even figure on the feed-screw dial. The slot 0.040 in. received an 18 B. & S. sheet-brass arm. A sheet of heavy paper was placed between the work and the top of the fixed jaw of the vise to allow the cut to go through without touching the jaw. A table of figures showing the set points for each cut was made to correspond with the dial on the cross-feed screw as follows; 85-170-5-90-175-10-95, etc. (the basic figure 85 is the sum of thickness of the cutter and the stock left between the slots).

The table is used in operation 7 by setting the dial at the second, fourth and sixth figures, etc.

Operation 3. Mill 120-deg. angle.

Operation 4. Mill 0.020 in. cut.

Operation 5. Mill 28-deg. 40-min. angle.

Operation 6. Carefully file and polish both angular faces to remove the tool marks. This provides the proper condition for contact with the ratchet-wheel teeth.

Operation 7. Parting (see operation 2 for use of table of figures).

Operation 8. After cleaning and drying, grain the sides (parting cut) on a fine lap wheel, afterward break all the corners with a No. 6 pillar file, care being taken not to touch edge *B*, which has been rounded slightly in operation 6.

Operation 9. Drilling. The jig for this operation was designed to locate the pawl with reference to the angular faces.

Operation 10. Countersink holes for rivets.

Operation 11. Caseharden.

Operation 12. Oil-stone face *C*.

In assembling with arm *D*, wire brads were used, and lapped flush with the surface.

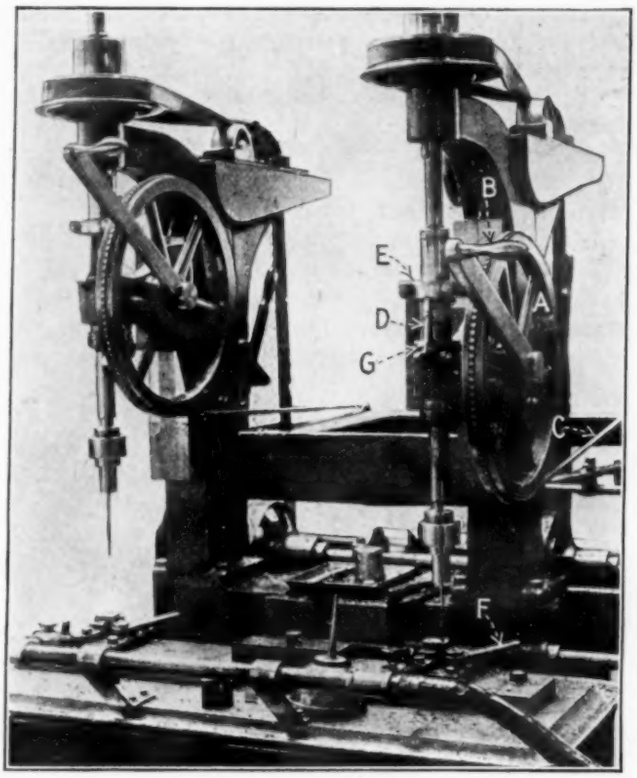
Weight-Regulated Feed for Drilling Machine

By J. V. Hunter
Western Editor *American Machinist*

Numerous devices have been noted from time to time for regulating the feed of high-speed sensitive drilling machines by means of pressure-feeding devices. An arrangement of this type, shown in the illustration, is in use in the plant of the Modern Tool Co., Erie, Penn.

The heavy wheel *A* has been placed on the shaft of the spindle pinion. This wheel has a handle *B* for lifting the spindle or starting the stroke as desired. The pressure of feed of each spindle is regulated by means of a weight suspended at the back of the machine. This weight acts through the flexible-steel chain *C*, which passes partly around wheel *A* and over a small pulley at the back of the machine.

After drilling a hole the operator takes the handle *B* and raises the spindle until the small dog *D*, which is controlled by a spring, snaps into place under the collar *E*. This holds the spindle up while the operator removes the work from the quick-action jig *F* and replaces it with another piece. When ready he releases



WEIGHTED FEEDING DEVICE

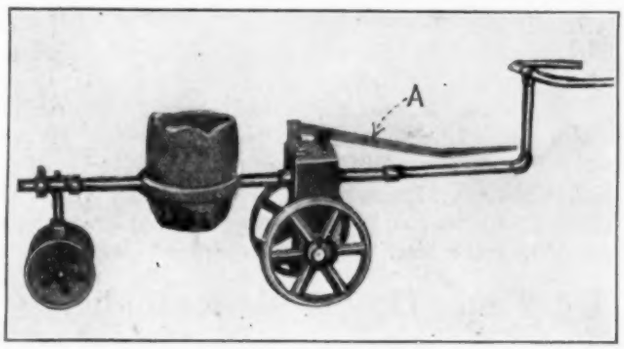
the spindle by pressing the release lever *G*, which trips the dog *D* and allows the drill to feed down. The pressure of the feed is regulated by the amount of weight hanging on the chain. The feed continues until the stop collar on the spindle sleeve reaches the top of the bracket. The operator runs two machines, and loads one jig while the piece in the other jig is being drilled.

A One-Man Crucible Truck

By E. A. Thanton

The general rule in a brass foundry is to employ two men to handle a crucible while pouring molds. Where the floor is in good shape a truck similar to the one shown may be used to advantage.

This is in use in the Northwestern R.R. shop in Chicago, and with it one man can easily handle a crucible after it has been placed in the truck cradle, as shown. A latch operated by the lever *A* keeps the crucible upright until the operator is ready to release it and pour a mold.



A ONE-MAN CRUCIBLE TRUCK

Mechanical Hands and Arms

BY J. A. LUCAS

The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

Shop-Production Diagrams

By Howard S. Rich

An efficient method of keeping tabs on the daily output of each department and the shop as a whole was faithfully worked out recently in a large industrial plant and gave some timely results. The effects were immediately shown by the extra efforts made by the backward departments as their sluggish ways were exposed every day to the other foremen who attended the executive meetings. For pride's sake a department that persisted in allowing work to lag behind the general average is urged to speed up to a level with the better work of the other departments and this generally has its good effects.

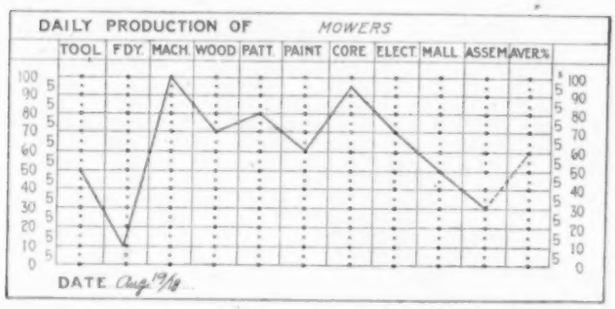


FIG. 1. DAILY BLACKBOARD DIAGRAM

The noonday meeting affords a good opportunity to assemble and tabulate the progress of work. An efficient clerk who takes full charge of the foremen's reports is in attendance and quickly calculates the necessary percentages. The results are shown on a blackboard, Fig. 1. Small cards, Fig. 2, for the daily production of any line of work in all departments are supplied to the foremen and between 11 a.m. and 12 m. these cards are hastily filled out, showing the approximate results of material in work up to the noon hour of each day. Regardless of the quantity of any particular article wanted the cards merely show the percentage of the work done on it.

The procedure is as follows: The foremen of the whole plant are informed of the line of data wanted and all parts pertaining to this line are looked up after 11 a.m. and listed. Thus, if at the next meeting the production of mowers is to be considered, all parts of mowers in work are tabulated in percentage and the clerk places each department's percentage on the blackboard. The result of this line of work throughout the plant is obtained by striking the average of all the percentages in a separate column, the outcome of which is instructive to all from the manager down to the slowest foreman. This diagram shows just who are behind and to what degree, and the slow ones are thus given an opportunity to speed up their departments during the afternoon and if necessary work overtime for good reasons. The graphic production line has been found very uneven at times, which proved that the departments were not pulling together.

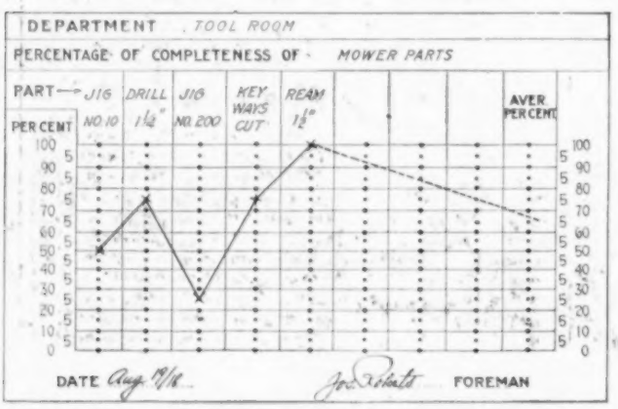


FIG. 2. DEPARTMENT DAILY REPORT CARD

These reports not only show the daily standing of work but they prevent the slow foremen from demanding bigger salaries than the results warrant, while the more efficient ones have nothing to fear from their good showings. The daily report card from each foreman is handed to the clerk at noon and is read off by him for any corrections. This shows just what parts are needed for any line of work or production wanted, and also shows which are receiving full, part or no attention when some discussion or excuses are likely to be forthcoming. The cards are signed and dated by the foremen and retained by the clerk for daily comparison, which means that they must be nearly correct in their estimated percentage or the foremen will have to answer. For instance, if Monday's card shows a jig 50 per cent. finished and Tuesday's card has the same figures, evidently no work has been done on it. If on Wednesday only 40 per cent. is shown then poor judgment has been used. If the jig is finished the card will show 100 per cent. in the jig column.

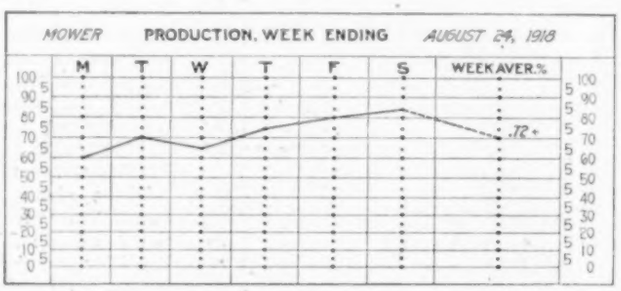


FIG. 3. WEEKLY AVERAGE BLACKBOARD DIAGRAM

Any foreman can easily mark the cards for any part wanted by judging if such parts, jigs or tools are one-quarter, one-half or fully finished and by making a small cross on the line representing 25, 50 or 100 per cent. in the proper column. Thus, if the foundry had an order to make 500 castings for mowers and by noon the foreman estimated that only 50 were ready he marked the card at 10 per cent. under the casting number. And if the toolroom had a jig that had to be used for mower drilling the foreman would estimate possibly that it was one-half finished and mark his card at 50 per cent. under the jig column. If the machine shop had 300 parts to be drilled and they were finished, the card would show 100 per cent. in the proper column.

Every Monday the general average for the previous week is shown by a separate blackboard diagram, Fig. 3, for any particular line of production, and when this falls very far below the preestimated amount there are always some strong requests to speed up. By referring to all the cards that make up this average for the week the foremen that pulled it down are easily spotted.

U.S. ARMY ORDNANCE NEWS

History of the Aberdeen Ordnance Proving Ground—III

By MAJOR F. P. LINDH*

The final installment of the Aberdeen Proving Ground History tells of the work done in the later months of the war after the various activities were in full swing. The development of the railway artillery, meteorological work and airplane bombing is taken up and some plans for future activities are discussed.

IN THE late spring of 1918, the first U. S. guns on railway mounts came through. In view of the great value of mobility in large guns and the success attained by European countries in developing railway artillery, the production of an American railway artillery was regarded as of the first importance, and everything possible was done to expedite the work. Railway guns of medium caliber had been designed and tested in 1916-17, notably the 6-in. pivot mount, but the shipping problem and the comparative adequacy of the Allies' supply of medium range guns caused it to be decided that the U. S. should concentrate mostly on large calibre, long range railroad artillery and hence these lighter guns were not developed during the war. By designing the early railway carriages to take guns already in use in the pre-war artillery, development work on ammunition was made possible by firing from fixed carriages at the same time that the new railway carriages were being constructed.

CAMOUFLAGED 16 IN. HOWITZER

Thus in the spring of 1918 an improvised fixed gun carriage was constructed at Sandy Hook and from it the 8-in. and 10-in. guns destined for the new carriages were range fired with new light-weight projectiles. In April the 14-in. naval gun was similarly set up and range fired at Sandy Hook. The 12-in. mortar was the next gun on a railway mount to be tested. Experiments on this did not proceed far, however, before all the railway artillery projects were transferred to Aberdeen where the construction of railroads and especially of firing tracks now enabled them to be handled. A series of spur tracks were laid out at the water range near Mulberry Point and preparations were made on a large scale for the reception of the expected guns. This site was chosen rather than the main front on account of the large space required for tracks, the operation of cranes, and the desirability of having a location where powder, fuse, and armor plate tests and range firing could all be conveniently carried out. In order to facilitate shipments a substantial wooden dock with railway approach was built at Mulberry Point and a channel was dredged into the deep water of the bay.

The first complete 8-in. railway mount arrived at Aberdeen about June 1, and shortly after the first 16-in. howitzer came in. These guns were fired with different powder charges, and at different angles with their tracks, they were s.ar gaged, disassembled and reassembled, records were taken of the action of their recoil mechanisms, time studies made on the operations of firing, and in many other ways they underwent searching investigations. Meanwhile more 8-in. railway guns came in and the 7-in. naval guns and 12-in. mortars on railway carriages arrived. A new section of the Proof Department was organized under the direction of Capt. C. C. Stretch to carry on the work, and the once quiet cornfields at Mulberry Point presented scenes of ever-increasing activity.

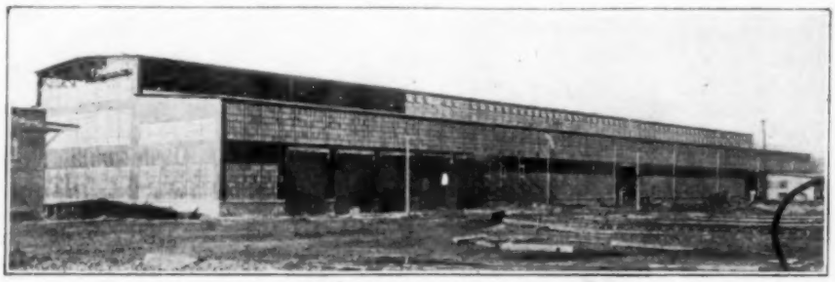
Camouflaging operations commenced at Aberdeen

*The writer wishes to express his appreciation of the work done by Lieut. P. L. Alger in gathering the material for this history. The major part of the credit for its arrangement is due to him.

ARMY ORDNANCE NEWS

under the direction of Mr. Goodwin almost as soon as the first railway gun appeared. All the railway mounts and their attendant cars were carefully decorated in outlandish designs and colors and studies were made of their visibility. Among other operations an artificial canopy of vegetation was constructed over a portion of a railroad spur and a 16-in. howitzer ensconced therein was searched for by airplane observers. It was found that viewed from above 2000 ft. the gun was invisible. This problem of rendering artillery invisible to enemy observers is one of the most fascinating of the newer scientific war problems and hardly a start has yet been made on its possibilities. It furnishes a fruitful subject for future investigation.

Another of the 14-in. naval guns was sent to Aberdeen about September 1 for range firing with a new projectile. Still later the 12-in. gun on a sliding railway mount which was designed and built in 85 days, and the 14-in. army gun, model 1919, came for tests and range firing. While most of this artillery was developed too late for use in the war, each type was thoroughly tested and brought from a theoretical basis to a practical or operating one and a large number of the 7-in. and 8-in. guns were tested, packed, and sent out for shipment overseas.



THE NEW MACHINE SHOP

Aviation was added to the proving ground activities in midsummer by the arrival of the 271st Aëro Squadron from Ellington Field. A landing field was prepared, and hangars and shops to the value of over a million dollars were built at a site about halfway between headquarters and the water range. The principal purpose of this project was to enable aërial drop bombs to be tested under actual service conditions. A bombing field of considerable extent was chosen near the shore of Bush River, inshore from the firing ranges and just north of the Edgewood Reservation, where high explosive bombs could be dropped without harm to lives or property. Here the aviators have dropped many hundreds of experimental bombs, the explosions or failures to explode being observed by Ordnance officers, from the air and from the ground. As a result of their coöperative efforts there were developed and put into production several satisfactory types of drop bombs and fuses, while experiments are now proceeding on a dozen improved varieties.

The aviators served other purposes both ornamental and useful besides the bomb dropping. They carried aloft meteorological instruments and observers who determined the upper air conditions so that the results observed in range firing could be properly corrected to normal atmospheric conditions. Beginning in November this service was performed three times daily and the results were used at Washington in constructing weather maps for the benefit of the mail planes as well as in the work of the Range Firing Section. Several of the pilots were very skillful in the air and their aërial stunts formed one of the most spectacular features of the proving ground on exhibition days. The airplanes used were at first all of the biplane training type equipped with Hispano-Suiza motors, but later two large Handley-Page bombing machines were received and made use of. The equipment of the field is of a permanent character and no doubt Aberdeen will become in the future an important government aviation center by reason of its favorable location.

The Proof Department as a whole was during 1918 in charge of the writer, and the work was divided into several sections, one of which has already been described. The Instrument Section should fittingly be described next as its work was necessary to all other sections. By it all photographic work, all velocity, time, and powder pressure measurements were made and electrical, drafting, and surveying work was performed. The section was organized in twenty separate units, each with its distinct functions. It carried on an enormous amount of routine work, in a year's time some 34,000 velocity measurements being made and about 2000 photographs taken. As many as 200 minor caliber guns have been star gaged in a single day. Its timekeepers measured with stop watches the times of burning of all time fuses and times of flight of ranging shots. Development work on improved pressure gages, recoil measuring devices, star-gaging apparatus, printing chronographs, and high-speed motion cameras was carried on with good results. The section is housed in a permanent brick building with well-equipped photographic laboratories, and is in a position to do excellent research work when the pressure of routine work decreases. The accumulated records of gun erosion, velocity dispersion, etc., furnish a wealth of data for future study. A separate Drafting Department is maintained which keeps on file all Ordnance Department drawings, and prepares sketches, maps, etc., for the Proof Department.

Each gun requires its own range table showing the normal range to be expected when the gun is elevated to any angle and also giving all the corrections necessary to apply to the normal range to allow for variations in atmospheric conditions, etc. In April, the Range Firing Section was established to conduct firing and computations to prepare such range tables and placed in charge of Capt. (now Major) O. Veblen, a very able mathematician. A staff of computers was built up by transfer of men from Sandy Hook, by obtaining college students, and by securing the services of talented enlisted men. Later several college professors of mathematics were called in to direct the computing and to devise new and improved methods and theories. This staff during the war reported upon some 10,000 shots fired for range, prepared and forwarded about 30 range

ARMY ORDNANCE NEWS

tables and greatly advanced the state of ballistic theory. The services performed by Lieut. P. L. Alger, Prof. G. A. Bliss of the University of Chicago, and Prof. H. H. Mitchell of the University of Pennsylvania have been particularly valuable.

To measure the ranges of projectiles an extensive system of 16 observation towers stretching for 30 miles has been built and equipped on the eastern shore of the bay, temporary towers on the western shore being used during the construction of the permanent ones. Observers spot the splashes of falling projectiles from their posts over 100 ft. above the water level in the same way that forest fires are located in the Adirondacks, and in fact the towers will also be used for forest-fire location. The positions of the towers have been accurately determined by the Coast and Geodetic Survey. Communication between the observers and the gun platforms across the bay was by means of wireless telephones, which were installed by the Signal Corps at Aberdeen early in the summer of 1918. To carry men and material to and from the towers a number of boats were required, especially in the earlier days when much surveying, building, and inspection went on. To fill this need a small navy was maintained by the proving ground consisting of one 76-ft. cruising yacht equipped with a wireless telephone, and half a dozen smaller motor boats. When the 14-in. railway gun was range fired observers were placed in lighthouses of Baltimore Harbor and all shipping was warned away, on which occasion the navy played an important rôle. Usually safety to shipping is assured by not permitting a shot to be fired until the observers report a clear field.

FIRING 12-IN. GUN ON SLIDING MOUNT

Before the war the conditions of the upper atmosphere were seldom taken into account by the U. S. Artillery but the development of high-angle fire has made this a very important consideration. To obtain the requisite knowledge of air conditions daily a detachment of the Meteorological Section, Signal Corps, was sent to Aberdeen in March. This detachment was largely increased later and was fully equipped with sounding balloons, kites, and other apparatus. Measurements of wind aloft and later of density aloft were made several times daily and the station grew to be the best of its kind in the United States. At the present time it is possible to obtain accurately the change in position of the point of fall of a projectile in both range and deflection that would be caused by a wind aloft, however variable, within five minutes after a sounding balloon has been observed at the height desired.

In the conduction of range firing it was frequently found that projectiles did not behave as expected, and as a consequence one of the most important tasks fulfilled by the Range Firing Section has been the carrying out of experimental firings to determine the effects of changes in projectile design. By such experiments it was discovered that by slightly altering the forms of the rotating bands on the 6-in. and certain other projectiles the range could be greatly increased and the dispersion decreased by an even more important amount. These discoveries which were largely due to Lieut. P. L. Alger were of great importance and formed the subject of several cablegrams exchanged with the A. E. F. As is so often the case, parallel discoveries were made at about the same time by the Naval Proving Ground and by the A. E. F. Many other alterations in projectile design leading to improvements were suggested by the Aberdeen staff. When all the immediately hopeful possibilities had been tried out or set under way Major Veblen, who had initiated most of the experimental work, was sent overseas to learn at first hand the latest ideas of our allies with the intention that he should return shortly to Aberdeen and put them into effect, thus avoiding costly duplication of effort. He could not sail until October, however, and the armistice prevented his trip being of service in the present war.

Almost all experimental ordnance work was performed by the Development Section of the Proof Department, the sections whose work have been described, being originally subdivisions of this section. It was capably directed by Capt. (later Major) A. L. Loomis, a reserve officer who had seen service on the Mexican border. Its duties comprised the testing of all guns and gun carriages, tractors and tanks, development of fuses, boosters, explosives, trench warfare material, the testing of new inventions, and the conduction of all tests in any way unusual, such as the development of the Aberdeen Chronograph.

The most spectacular feature of the development work was the testing of tanks and tractors. The caterpillar tractor early in the war proved its value and quite a large variety of guns were put on tractor mounts, notably the 155-mm. G.P.F. gun, 3-in. anti-aircraft gun and 8-in. howitzer. These ungainly vehicles were put through many tests in the Aberdeen mud, through the woods and over obstacles with great success. In addition to the gun carriages there were several small tractors, designed to draw guns and limbers formerly horse drawn, which underwent tests. Tanks did not form an important feature of the work at Aberdeen as but very few were sent there. Other methods of supporting guns were tested, such as

ARMY ORDNANCE NEWS

rubber-tired wheels, cast-iron wheels and finally no wheels at all. The development of these various gun mounts and caterpillar vehicles only entered its initial stage during the war and it seems certain that in future warfare the use of small armored tanks to draw light guns and the provision of caterpillar mounts with their own power for medium-sized guns will feature as much as will large guns on railway carriages.

The testing of anti-aircraft fuses formed the principal night activity at Aberdeen. To hit an airplane, reliance is placed on a time fuse set to explode a projectile near the plane, and the time of burning for any setting of such fuses must be ascertained by experiment. Since the flashes of shell bursts were much more visible at night, tests were usually conducted from midnight on. The star-like flashes were visible in the sky for many miles as also were the flashes of the blast from the gun, the combined illumination making a fascinating spectacle from Havre de Grace and other nearby towns. Over 10,000 anti-aircraft fuses and over 40,000 of other types of time fuses were tested at Aberdeen during 1918. The Acceptance Section of the Proof Department, headed by Capt. (now Major) J. E. Fullam, performed all tests of manufacturers' samples to determine the acceptance or rejection of the material represented. Its work comprised six principal divisions, the tests of powder, projectiles, cases, fuses, complete rounds and bombs. So great was the pressure of this work that frequently tests were carried on twelve and fifteen hours a day. Almost all the acceptance tests were of a routine character so that the question of how rapidly they could be done was paramount. Aided by telegraphic and messenger service it was usual for reports recommending acceptance or rejection of material to be received in Washington within 48 hours after the arrival of the ammunition at Aberdeen. The acceptance work involved the firing of about 200,000 rounds up to Jan. 1, 1919, the volume of firing increasing from 7716 rounds in March and 13,211 in May to 24,501 in August and 36,039 in October. These firings indicate that about 25,000,000 explosive projectiles were accepted by the Ordnance Department during the year 1918.

MAKING UP A 12 IN. POWDER CHARGE

Projectiles were tested by firing them under excess powder pressure to a chosen field 5000 yd. or so from the guns, and then digging them up for examination. It may be said with emphasis that the daily routine of digging up shells that are buried from three to six feet deep in clay-mud and water lacks all the elements of romance. The enlisted men who did the work had the added pleasure occasionally of dodging stray shots, but no casualties ever resulted. To lessen the arduous character of the recovery work projectiles were fitted with flat plaquettes that decreased their striking velocity and penetrative power, and also prevented ricocheting, but no other radical improvements in the recovery work were made. On account of the percentage of large shells lost beyond recovery by their penetration below the water level in the marshy soil, however, it was seen that an entirely different method of procedure would be desirable. Accordingly a concrete tank of large dimensions was built after some experiments and it is intended to fire projectiles into water contained in this tank at close range. It is expected the water will retard the shells without injury sufficiently to retain them within the tank and that they can be then lifted out with magnets. This device has just been tried for the first time and bids fair to be a great success. Recovery tests have proved of great value in many ways and they will form a feature of future proving-ground work, although they were rarely performed at proving grounds before the war on account of the limited space available. Over 40,000 percussion and detonating fuses were tested at Aberdeen in 1918. These tests were carried out on the detonating ranges by firing high-explosive shells down the range for distances of from 400 ft. to 8 miles so that they burst within 50 yards or so of observers stationed in bomb proofs just off the line of fire. These observers could tell by the appearance of the detonation how well the fuses functioned. This work is one of the most dangerous proving-ground occupations as fragments of shell frequently strike the bomb proofs and occasionally enter the narrow slits left open for vision. Lieut. Buffington lost the sight of one eye as a result of being struck by such a fragment and other officers have had narrow escapes. Another source of danger is the liability of experimental fuses to detonate prematurely, perhaps wrecking the gun. Quite a number of guns have been ruined in this way during 1918, but fortunately no serious injuries have resulted from these prematures, thanks to careful safety rules that were enforced. The loading, assembly, and handling of this explosive ammunition requires great care if accidents are to be averted.

The trench warfare work during the latter half of 1918 was carried on under the direction of Capt. S. K. Bushnell and was signalized by general improvements in early designs and a great volume of acceptance

ARMY ORDNANCE NEWS

tests. Oddly shaped bombs with tails and fins that make them fly true and arrow-like replaced the cylindrical and tapered projectiles that tumbled in flight; while new and consistent powders replaced the erratic burning ones first tested. A very large number of trench mortars were given routine tests and packed for shipment overseas. One serious accident marred the work of this range when two men were killed by the accidental explosion of a shell in a Stokes mortar. Like the tanks and tractors, the trench warfare devices are all new elements of warfare and their possibilities for improvement are still unlimited.

The Future of the Proving Ground

The proving ground will be a permanent experimental firing ground which will provide for all possible peace-time needs. The major caliber seacoast guns will be transferred from Sandy Hook, and powder tests and armor-plate tests with them will be added to the Aberdeen projects. Permanent buildings are under way which will provide space for the activities now housed in cantonments. Substantial quarters, good roads, railroad facilities, and its pleasant location will make Aberdeen an attractive post at which to live after the construction work is finished, the temporary structures removed and the land graded. It is hoped to make it the center of ordnance activity and knowledge, and to establish here a good Ordnance School for officers, an ordnance library and a permanent staff of experts who will do research work leading to improvements in materiél. In England and France it is planned to provide attractive opportunities for men of ability to make permanent careers in ordnance work; and it is certain that such a policy will produce far better results than the old scheme of making the entire proving-ground personnel a continually changing one.

The experiences of the war of 1917 have shown that a large number of untrained men can be gathered, disciplined and made into trained fighters far sooner than the suitable amount of ordnance equipment can be developed and manufactured. Accordingly any preparedness scheme whatever should provide for an adequate number of ordnance experts permanently employed by the Government and the maintenance by them of complete plans and specifications for up-to-date materiél suitable for a large army. This would involve such a small number of men as to discount effectually arguments against militarism and at the same time would provide a most effective form of preparedness against possible contingencies of the future. Whatever decisions may be made at the Peace Conference the development of American ordnance will largely depend upon the results of experiments that will be made at the Aberdeen Proving Ground.

Abstracts of Recent Office Orders of General Interest

No. 573, Mar. 4. Col. James L. Walsh is appointed chief of the executive section, office of the Chief of Ordnance.

No. 551, Feb. 17. Lieut. R. E. Westervelt is designated contracting officer for the Chicago Ordnance District, succeeding Maj. F. R. Schanck.

No. 554, Feb. 18. Maj. A. S. Douglass is appointed Ordnance District Chief, Boston district, succeeding Mr. Levi H. Greenwood, resigned, to take effect Feb. 20.

No. 556, Feb. 18. Maj. Allan Copperthwait is appointed a member of the Detroit District Claims Board, succeeding Maj. P. C. Thomas, effective Feb. 3.

No. 559, Feb. 21. Maj. Paul Weeks is designated as chief of the Tank, Tractor and Trailer Division, succeeding Lieut.-Col. H. W. Alden.

No. 564, Feb. 26. B. Goldsmith is appointed Ordnance District Chief, New York, succeeding George J. Roberts, resigned, to take effect Mar. 3.

No. 565, Feb. 28. Capt. T. F. Geraghty is appointed alternate member of the Baltimore District Claims Board.

No. 568, Mar. 1. Maj. Sherman L. Depew is designated as alternate member of the Detroit District Claims Board.

No. 568, Mar. 1. Capt. George Featherstone is designated as alternate contracting officer for the New York District Claims Board.

No. 569, Mar. 3. Capt. James G. Dalgliesh is designated as alternate contracting officer for the Detroit District, with authority to approve vouchers, during the absence of Maj. Joseph A. Bursley.

No. 571, Mar. 4. C. E. Huyette is appointed Ordnance District Chief, Detroit District Ordnance Office, succeeding Fred J. Robinson, resigned, effective Mar. 15.

No. 577, Mar. 10. Maj. R. H. Hawkins, Maj. A. C. Hindman and Capt. E. D. Cooper of the Administration Division are authorized to execute, where necessary, contracts incident to the sale or disposition of material, equipment and property, in order to carry out the requirements of Supply Circular No. 117, P. S. & T. Div. dated Nov. 21, 1918.

No. 580, Mar. 12. Maj. F. B. DeGress is appointed member of the New York District Claims Board.

PERSONALS

First Lieut. Hugh J. Falvey has left the service. He was commissioned from Fort Sheridan Training Camp in November, 1917, and has served continuously at Rariton Arsenal as supply officer.

* * *

Second Lieut. Raymond W. Peters has been discharged. He is a graduate of both Washington and Missouri Universities, and was formerly employed by the Canvas Products Co., 15th and Olive Sts., St. Louis, Mo.

* * *

First Lieut. Arthur W. Wainwright has left the service. He is a graduate of New York University and was commissioned in December, 1917. Lieutenant Wainwright has been on duty with the Production Division.

* * *

Capt. William S. Trask has been discharged after one year of service. Before being commissioned he was employed by the American Hardware Co., New Britain, Conn. His service has been in connection with inspection work.

ARMY ORDNANCE NEWS

Maj. John H. Barr, recently discharged, is a graduate of the University of Minnesota. He is a mechanical engineer, and before being commissioned was in charge of the engineering department of the Remington Typewriter Co.

* * *

Capt. Harry W. Cross, recently discharged after serving 14 months, has been on duty with the Procurement Division as head of the gage branch. He was formerly employed by the General Electric Co. as purchasing agent.

* * *

Second Lieut. William R. Flemming, who has been on duty with the Supply Division and has served at various camps, has left the service. He was formerly employed by the Connecticut Valley Lumber Co., 147 Milk St., Boston, Mass.

* * *

First Lieut. Ralph M. Davies has left the service. He graduated from the University of Minnesota as an electrical engineer and was formerly employed by Fairbanks, Morse & Co. on the sale and installation of gas and electrical equipment.

* * *

Maj. A. E. White, who was commissioned in August, 1917, and was on duty in Washington, D. C., has been discharged. He was a student at Brown University and Harvard University and was formerly employed by the Detroit Edison Co., Detroit, Mich.

* * *

Capt. Alexander H. Robertson has been discharged from the service. He is a graduate of Union College, and is a civil engineer. Previous to his being commissioned, Captain Robertson was employed in the designing department of the New York Central R.R.

* * *

Second Lieut. Frank S. Bonds, recently discharged, is a graduate of Clemson College and a mechanical engineer. He entered the service as an enlisted man in December, 1917, and served in the aircraft armament section, Engineering Division, until he went overseas.

* * *

Second Lieut. George W. Alsdorf, who is a mining engineer, has been discharged from the service. He is a graduate of the Ohio State University and prior to being commissioned was employed by the New Mexico-Colorado Coal and Mining Co., Raton, New Mexico.

* * *

First Lieut. William H. Wharton, who was commissioned in January, 1918, has been discharged. He was formerly with the Nashville, Chattanooga and St. Louis Railroad Co., Chicago, Ill., as commercial agent. His service has been with the Production Division on transportation matters.

* * *

Maj. Charles L. Pratt, who was commissioned as Captain in August, 1917, has been discharged. He was formerly employed as works superintendent by the Boston Gear Works, Norfolk Downs, Mass. Major Pratt has been on duty at the Watertown Arsenal since being called to active duty.

* * *

First Lieut. Leonard J. Dibble, who was commissioned from Plattsburg in November, 1917, has left the service. He is a graduate of Trinity College and was formerly employed by Kissel, Kinnicutt & Co., 14 Wall St., New York. His services were with the artillery ammunition section of the Engineering Division.

* * *

Second Lieut. Albert Grobstein, who was formerly a student at the Carnegie Institute of Technology and specialized in mechanical engineering, has been discharged. He was formerly employed by Firth-Sterling Steel Co., McKeesport, Penn. Since being commissioned he has been on duty at the Aberdeen Proving Grounds on proof work.

* * *

First Lieut. C. H. Shattuck has been discharged. He was a student at Leland Stanford University, and was formerly employed by C. F. Braun & Co., San Francisco, Calif.

* * *

First Lieut. Ross H. Forney, who was commissioned in August, 1917, has been discharged. He was formerly employed by the Texas Power and Light Co., and is a graduate of the University of Kansas. Lieutenant Forney was assigned to proof work for the greater part of the time since he entered the service.

Distinguished Service Medal for Guy E. Tripp

THE processes of the War Department are sometimes slow but they generally arrive at their destination in course of time whether it be the apprehension and incarceration of a draft dodger or the decoration of an eminent reserve officer who has laid aside his uniform and returned to his old duties.

Mr. Guy E. Tripp, whose record in the Ordnance Department is well known, has resumed his work as chairman of the board of the Westinghouse Electric and Manufacturing Co., 165 Broadway, New York. He is a director of many important corporations and a member of numerous clubs and societies, a full account of which was published in our issue of Feb. 6, 1919. We take pleasure in publishing the citation which gives him the distinguished Service Medal.

GUY E. TRIPP

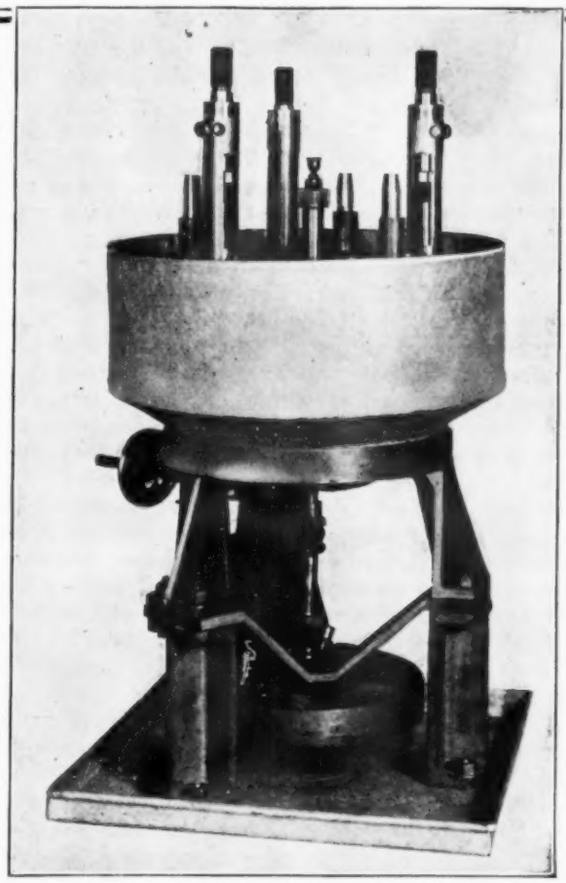
Formerly Brig.-Gen., Ordnance Department, U.S.A., "who, as Chief of the Production Division of the Ordnance Department, and later as Assistant Chief of Ordnance, displayed fine technical ability and broad judgment in systematizing methods and practices resulting in the efficient coöperation of industries producing articles of ordnance for the Army."

A Machine for Lapping Precision Gage Blocks

For ten years, the manufacture of precision gage blocks has been considered the great mechanical secret of the world and much mystery has surrounded the production of these blocks. As a matter of fact with proper equipment and the necessary skill, they are much more easily and accurately made than are precision screws when made to tolerances ten times as large.

THE illustration shows a machine for lapping precision gage blocks with flat and parallel opposite sides a definite distance apart, or other similar work. This machine is the latest of a series of machines designed and built by the inventor and patentee, E. A. Suverkrop, New York, for producing gage blocks of any contour but having two opposite sides flat and parallel and a definite distance apart.

After the rough-ground gage-block blanks are correctly placed in the workholder of the machine and it is set in motion, but little further attention is required. Blocks made on the original experimental machine some years ago and inspected by means of glass optical planes were found to be the same size, so far as this precision method of measurement could determine, and interchangeable with the master measuring blocks used.



A MACHINE FOR LAPPING PRECISION GAGE BLOCKS

The machine consists of three circular plates two of which are lapping plates. The lower lapping plate is stationary. The upper lapping plate is also stationary, so far as rotary motion is concerned, but is free to move by gravity toward or to be moved from the lower lapping plate. The guiding members for the upper lapping plate prevent it from rotating with the workholder but do not constrain it to move parallel to the lower lapping plate. They permit the upper lapping plate to automatically adjust itself to the inequalities of the rough-ground gage-block blanks which are being lapped.

The third circular plate is located between the upper and lower lapping plates and serves as a work carrier. Near its perimeter are openings similar in contour to the gage-block blanks. If these are cylindrical, the openings are cylindrical, and if they are rectangular or any other shape the openings in the work carrier are the same shape but slightly larger. The thickness of the work carrier is less than the thickness of the gages to be lapped so that their opposite faces can come in contact with the faces of the upper and lower lapping plates respectively. A combined rotary and oscillating or planetary motion is imparted to the workholder so as to carry the faces of each and all of the gage blocks being lapped over every portion of the entire lapping surface of the contiguous lapping plate.

In this machine measuring blocks or other mechanism can be used for determining or limiting the extreme travel of the upper lapping plate toward the lower lapping plate and the consequent ultimate size of the work. The lubricating system is entirely self-contained and is so arranged that any stoppage can be at once detected and the cause located. The cut lubricant is supplied by a centrifugal pump through a series of nozzles. The latter can be directed so that the fluid pour in a series of steady streams over the entire faces of both laps keeping them and the work thoroughly flooded. The waste lubricant after passing the work flows by gravity to a series of strainers and settling compartments through which it flows depositing all of the larger particles of grit. The cut lubricant passes finally through a filter system which entirely removes all foreign matter.

The coefficient of expansion of the parts of this machine which control the size of the gage blocks is the same as that of the steel used for the precision gage blocks, however to keep the work at constant temperature a simple refrigerating system, not shown in the illustration, is provided for the cut lubricant before it again passes to the circulating pump. The refrigerating system can be operated either mechanically, or with ice in the summer, or with cold water under city pressure in the winter.

Hardening, seasoning, detection of cracks and the positive determination of size are details of manufacture all of which have been successfully solved so there is now no mystery about the production of gage blocks of extreme accuracy.

EDITORIALS

Training for Increased Production

THE war brought us face to face with the necessity of training large numbers of unskilled workers in the shortest possible time. Training schools were established in many shops under various names, and the work they were able to accomplish, even under adverse conditions in many cases, astonished even those who originated them.

Now that the war necessity has disappeared, we stand at the parting of the ways with regard to their being dropped or their continuance under peace-time conditions. Few who have really studied the question will, we believe, fail to see the great necessity for their continuance.

Granting that the training school has its place, the question now before us is how to use it to the best advantage for the present and future of the industry. During the present readjustment period, the need for training new workers has largely disappeared, but we are finding what we might have expected had we given it sufficient thought, that it is fully as important to train the employees we already have to be more efficient in their work.

We have assumed that when a worker went into the shop and held the job, that there was nothing more to be done; that they either knew the business before or had acquired enough of it to be classed as good workers. Yet every shop has a full quota of workers who we know are less efficient than they might be, but who are enough above the "firing" line to hold their job in normal times. Through no fault of their own in many cases they seem unable to progress beyond the point of making it difficult to find a legitimate reason for dismissing them. This is in part due to the fact that we realize the new man may be no better. It is a case of keeping the faults you know rather than getting faults of which you know nothing.

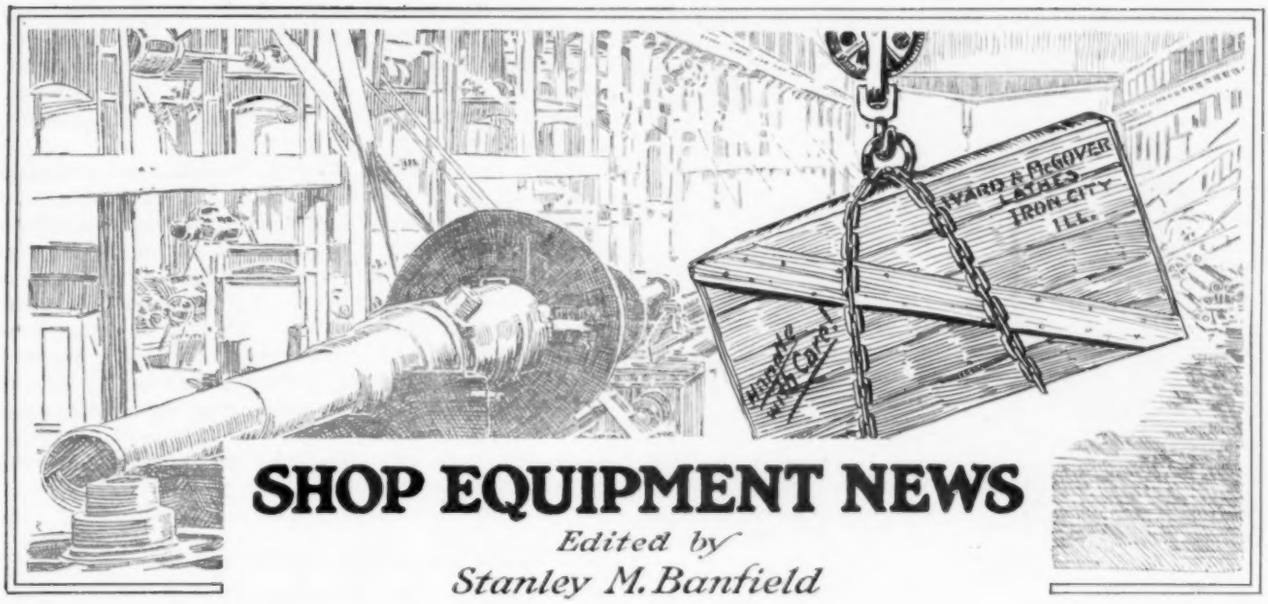
The training school offers an excellent opportunity for not only increasing the efficiency and consequently the earning power of employees, but at the same time securing their interest and coöperation along other lines. Some far-seeing managers are utilizing the present to re-train or "up-grade" the workers who seem to need it and who respond to such an opportunity. Those who believe that the only place to train workers is in the shop, and most of us have held to this fallacy at some time or other, have much to learn as to what proper methods, proper equipment and the right personality can accomplish in this line. Men and women who have failed to make good in the shop, or who fall even a trifle below a normal standard, are never secure in their positions. This adds to their mental anxiety and acts to prevent them from doing as well as they otherwise might.

Employees of this kind can be trained and are being trained to greatly increase their product. In some cases the foremen object to letting them go back into the training school, fearing that it may be a reflection on their ability to teach those under their care. But we are beginning to realize that showing how a piece of work is done and teaching how to do it are two very different things, and that while many can show the new worker, very few have the real teaching instinct. The foreman should be made to feel that the up-grading of his workers in the training school is no criticism of him, that his work in securing production leaves him no time for the real teaching which is necessary, and that you are trying to help him make a good showing in his department by relieving him of a burdensome part of his duties.

This work of up-grading is making itself felt even though it is so new in most cases. It is taking workers who are only of mediocre capacity and making them capable of turning out much greater product and earning much more money. In some cases workers who could barely turn out the minimum have more than doubled their production after a few weeks' instruction. Nor is this instruction all an expense as some might think. They are trained for the most part on the kind of work they have done in the shop and they turn out a commercial product while in the training school. In fact, wherever possible, all training even with beginners is on commercial work. There are cases of course where it is better to forget production during the training period, but on some kinds of work it is perfectly possible and practicable to combine the two. With the proper spirit behind the training school there is no question as to its effect on the morale or personal relations of the whole plant. It shows that there is an interest in helping workers to make good and to earn more money. It gives an employee in one department the opportunity of making good in some other place, saving for the company that intangible but nevertheless real value which comes from continued service and familiarity with its products.

The training school must carry a living wage in order to make it possible for those who need it most to avail themselves of it. This is not a serious problem when there is some product coming out of the school every day, and even in other cases it is usually less expensive than the loss in labor turnover. In some cases men who have earned good money ask to spend a short time in the training school at the lower rate of pay in order to make themselves worth more when they go back into the shop. Such a spirit cannot fail to make itself felt in the future product of any firm.

This up-grading of workers is not a fad or philanthropy. It is a paying business proposition and is proving itself in many places. It increases the earning capacity of the worker but it gives more production from the same shop equipment and the same overhead expense. It enlarges the productive capacity of the whole shop without the expense of new buildings, new machinery, more executives and more taxes. And last, but not least, it increases the coöperation and shop harmony which means so much in the total cost of operating any business. Up-grading of workers to secure more and better production will help greatly in our problems of readjustment.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Cadillac Double-End Drilling and Centering Machine

The Cadillac Tool Co., Dodge Power Building, 268 Jefferson Ave., Detroit, Mich., has just placed on the market the double-end drilling and centering machine shown in the illustration. The machine, although primarily intended for centering both ends of a shaft simultaneously, may be adapted to a wide range of work where it is desired to drill from opposite directions. The machine is of such construction that two ¾-in. drills can be used simultaneously and the bed lengths are such as to take 12, 24, 36, 48, or 60 in. between centers, as desired. The belt-driven machine is shown in Fig. 1, but motor drive can be furnished, the motor being mounted under the pan at the right end of the machine and driving through a Link-Belt silent chain running in a bath of oil. The machine can be so arranged that the left-hand head is removable, enabling longer shafts to be centered, or if desired it can be furnished with only one drilling head. In Fig. 1, the standard machine is shown arranged for countershaft drive but if desired tight and loose pulleys can be furnished to drive direct from the lineshaft. In this case the loose pulley and countershaft bearings are arranged with Hyatt high-duty bearings. The drive from the pulley shaft to the spindle shafts is through Link-Belt silent chains running in oil baths, the end thrust being carried on ball thrust bearings. The spindles are made from hammered crucible steel, heat treated and ground to size. Fig. 2 shows the standard vise furnished, which has a capacity for round stock up to 4 in. in diameter. The screws are provided with end adjustment to enable the vise jaws to be set off center if desired. The vise jaws are of tool steel hardened and ground, and are removable, so that special jaws can be substituted. The manufacturers are also in a position to furnish special fixtures in place of the standard vises. The machine is regularly furnished with an oil pan, pump, and piping for circulating cutting lubricant. Special attention is called to the fact that the customary type of drum countershaft has been eliminated.

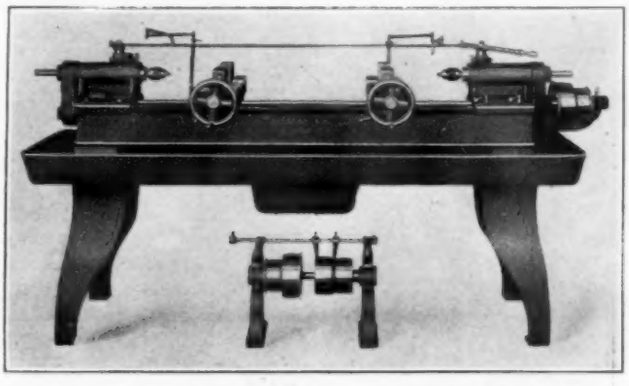


FIG. 1. CADILLAC DOUBLE-END DRILLING AND CENTERING MACHINE

Capacity, round stock up to 4 in. in diameter; maximum drill size, ¾ in.; distance between centers, 12, 24, 36, 48, or 60 in. as desired; spindles, hammered crucible steel, heat treated and ground

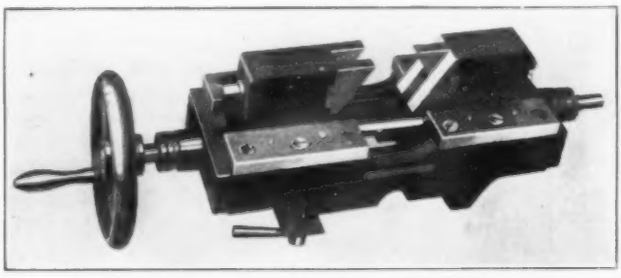


FIG. 2. THE STANDARD VISE

Automatic Milling Machine

A new adaptation of the small special purpose milling machine built by the Automatic Engraving and Manufacturing Co., of 2033 Fifth Ave., New York City, is shown in Fig. 1. A two-position holding fixture is shown attached to the reciprocating table and the work for which it is adapted is the routing of the peculiar-shaped slot in a special form of locknut shown in Fig. 2.

The spindle of the machine runs in bronze bearings the latter being tapered on the outside to allow com-

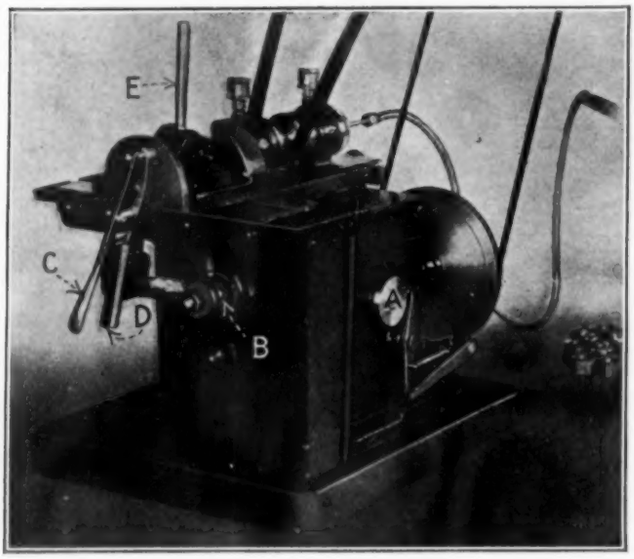


FIG. 1. AUTOMATIC MILLING OR ROUTING MACHINE

pensation for wear by endwise adjustment in the usual manner. A ball thrust bearing is provided to sustain the endwise pressure imposed by the work. This bearing is inclosed by a dust-excluding cover which is made as a part of the driving pulley in order to make the head as compact as possible.

The working end of the spindle is provided with a spring collet to hold the cutter which in this case is an end mill ¼ in. in diameter. Both spindle and cutter are hollow and lubricant is supplied through the spindle directly to the cutting point by means of a small pump and flexible tube connection. The spindle runs 3500 r.p.m. for this work, the material being cold-rolled steel.

The movements of the head and work table are derived from a horizontal shaft driven by the large grooved

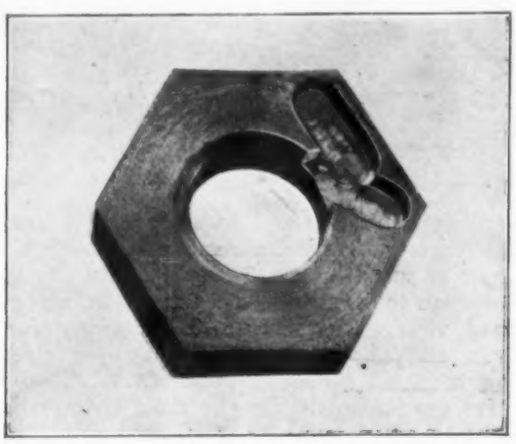


FIG. 2. WORK DONE BY THE MACHINE

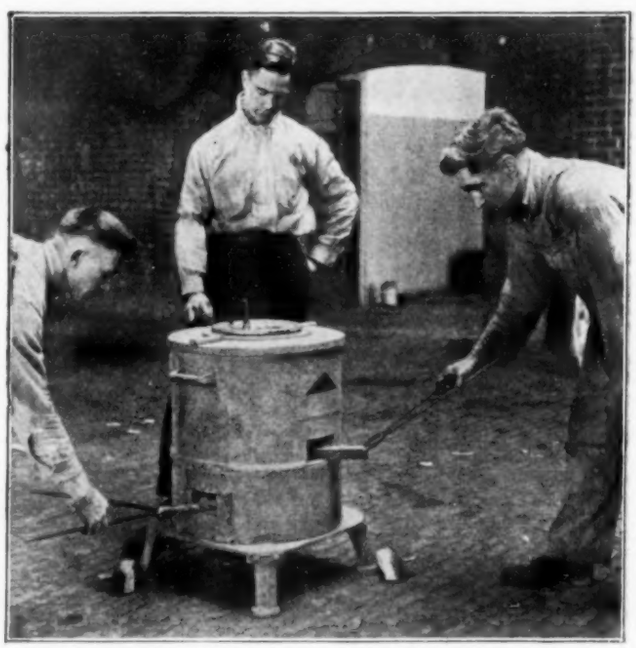
pulley which may be seen at the rear of the machine. The pulley runs idly upon the shaft but may be clutched to it by a movement of the starting lever. A worm-driven cam mounted upon a transverse shaft the end of which may be seen at *A*, Fig. 1, furnishes the forward or feeding-in movement of the head. The disk on the end of shaft *A* is a knockout device that releases the clutch and stops the movements upon completion of the cycle of operation. To the right of, and below this disk in the illustration may be seen the latch levers that hold the operating clutch in engagement until released by the knockout. The work table is given a slowly reciprocating movement through the medium of a crank at *B* which is the usual slotted disk and movable stud, providing for the adjustment of the table stroke within reasonable limits.

The work shown in Fig. 2 requires two cycles to complete it and the fixture shown in place on the table in Fig. 1 is so arranged that when one cycle is completed the operator has but to shift the position by pressing the latch release lever *C* and pushing the handle *D* through an arc of about 20 deg. where it will latch into the second position. A touch of the clutch lever starts the machine upon its second cycle. The handle *E* is the clamping lever for holding the work.

The machine is very compact, occupying a space about 14 x 18 in. square and 12 in. high. The weight is approximately 200 lb. The time of each cycle on this work is 28 seconds.

"Triad" Three-Purpose Heat-Treating Furnace

The W. R. Bennett Co., Elmwood, Conn., has just placed on the market the "Triad" three-purpose heat-treating furnace shown in the illustration. In this furnace three heating operations can be carried on at one time by three men without interference; namely, heating for hardening in a lead or cyanide bath, heating for hardening in a semi-muffle furnace, and heating for forging in the combustion compartment. It is stated that the furnace in no way resembles the numerous lead-bath or pot furnaces on the market at the present time, except in exterior appearance. In spite of the fact that these three operations may be carried on at one time, only one burner is used, which may be operated with either gas or oil. The lead pot does not rest on a pedestal or supporting brick, but hangs in



"TRIAD" THREE-PURPOSE HEAT-TREATING FURNACE

Floor space, 2 sq.ft.; height, 31 in.; weight, 550 lb.; burner for oil, ¾ in.; burner for gas, 1 in.; size of pot, either 6 or 7 in. in diameter and 11 in. deep; time taken to obtain tool-steel temperature from cold start, 35 minutes.

suspension from the heavy split iron covers forming the top of the furnace, a feature that is said to give a uniformity of temperature from the bottom to the top that is not possible when the pot rests upon a supporting base. The flame itself does not come into contact with the lead pot, as the combustion chamber is an entirely separate unit. The products of combustion pass upward into the pot-heating chamber through openings around the inside periphery of the brick top of the combustion chamber. This method distributes the heat to the heating chamber, and is said to insure absolute uniformity of temperature over the entire pot area at all times. It also serves to eliminate oxidation to a very large extent, making the life of the pot considerably longer than that in other types of furnace. The pot-heating compartment also performs the function of a semi-muffle furnace, and the operator at the right is using this feature. An opening at the base of the compartment allows dies and tools to be heated on the brick roof of the combustion chamber. There is another opening into the lower part of the combustion chamber where pieces of work can be heated for forging. Aside from the fact that the life of the lead pot is considerably longer, it is claimed that the fuel consumption is also reduced to a very marked degree, on account of the more perfect combustion. Two sizes of lead pots may be used in the furnace, either 6 or 7 in. in diameter and 11 in. deep. It is stated that tool-steel temperatures may be obtained in the furnace from a cold start in 35 minutes.

Logan Air-Operated Chucks

The air-operated chucks shown in the illustration have just been placed on the market by the Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., being manufactured by the Logansport Machine Co.

Fig. 1 shows a sectional view of the three-jaw, air-operated, combination chuck. It is said to combine maximum power with minimum weight and simplicity of operation. The body of the chuck is a one-piece casting, eliminating all bolts, screws, or other parts, and it is said that the jaw-operating mechanism is new to

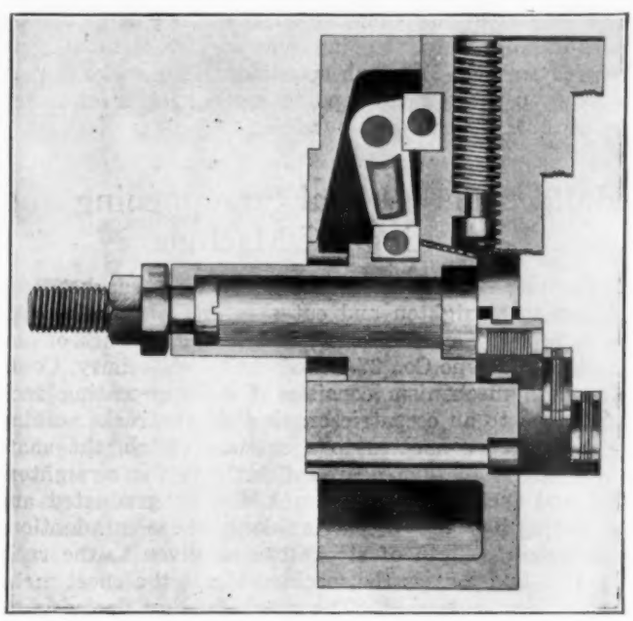


FIG. 1. LOGAN AIR-OPERATED COMBINATION CHUCK

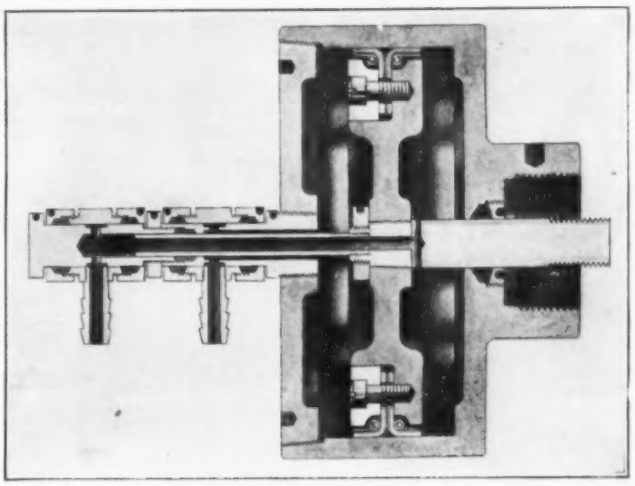


FIG. 2. LOGAN DOUBLE-ACTING AIR CYLINDER

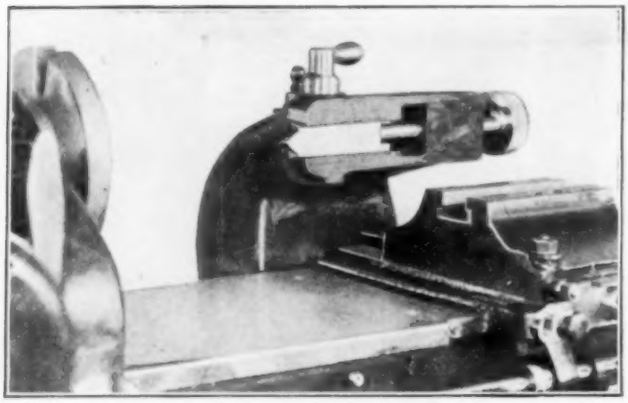
air-chuck construction. A special heat-treated lever is used, to which are pivoted hardened- and ground-steel blocks which engage in hardened and ground ways in both the draw tube and chuck draw slide, thus eliminating wear and friction to a great extent. The mechanical advantage obtained by the lever used is three to one. The chucks are as near dustproof as it is possible to make them. In order to reduce friction and wear a piece of felt is inserted between the draw tube and the chuck-jaw slide, this also serving to make a dustproof joint and eliminating chips and dirt from the operating mechanism. Provision is also made in the draw tube for inserting a bushing for supporting the boring bars.

Fig. 2 shows the double-acting air cylinders used. It is stated that packings have been made accessible for quick adjustment. The piston embodies the use of the Johns-Manville air-cylinder packing cup and expander ring. The base of the packing cup is woven asbestos. The cold-rolled-steel spring expander ring holds the packing up against the bore of the cylinder, giving a pressure surface $\frac{1}{2}$ in. wide around the bore of the cylinder. When the air is applied to the cylinder, it enters the channel between the outside of the piston and inside of the expander rings, thereby increasing the pressure of the packing cup against the bore of the cylinder and giving a tight joint. The Logan air valve for operating the cylinder is made from a semi-steel casting fitted with a hand-lapped bronze tapered plug and is piped direct to the cylinder without the use of elbows or any other fittings. All internal parts are accessible for cleaning and oiling by unscrewing the cover. The handle is reversible so that the valve can be located in any position on the machine.

These Logan double-acting air cylinders are regularly made in 3-, 4½-, 6-, 8-, 10-, 12-, 14- and 16-in. bore.

Porter-Cable Tailstock

The Porter-Cable Machine Co., Syracuse, N. Y., has recently brought out a new tailstock and center for their lathe, which will be found valuable on many lathe operations. In this construction the usual tail-spindle is omitted and the ordinary center is replaced by a dovetail slide having a center point formed on one end. The illustration shows the means provided for moving the center in and out, and also the usual manner of clamping it in position. No portion of the center



PORTER-CABLE TAILSTOCK

or adjacent parts projects forward toward the operator more than $\frac{5}{32}$ in. from the center point, so that when turning a part as small as $\frac{5}{16}$ in. in diameter, it is unnecessary to draw back the cross slide when it is desired to run the carriage and tool to the right past the tailstock for the purpose of measuring or filing the work. The device is especially valuable when using a gang toolholder with multiple tools for turning parts having several diameters, one or more of which may be smaller than the ordinary round tail spindle, and the over-all length sufficient to preclude the use of a gang of tools if it were not possible to run past the tailstock as shown. It is also convenient in connection with a turret toolpost as it is unnecessary to draw back the cross slide to provide room for swinging the tool when indexing.

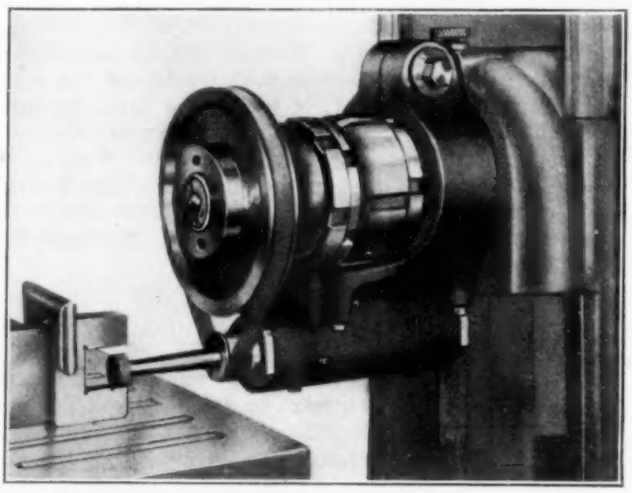
The center may be ground back $\frac{3}{4}$ in. before renewal is necessary, but it is recommended as a matter of economy that several centers be kept on hand ground ready for use. A special fixture for grinding is furnished with each equipment. This improved tailstock can be readily applied to Porter-Cable lathes now in use, due to the fact that the grinding fixture is adjustable to conform to the alignment of the lathe on which it is to be used. A setting gage and complete information goes with each outfit.

Liberty Grinding Attachment

The grinding attachment shown in the illustration is now being marketed by the Liberty Tool and Gauge Works, Woonsocket, R. I. This attachment is designed to be attached to surface grinding machines for the purpose of using wheels of small diameter running at high speeds. The device is so constructed that it can be quickly secured to the machine, and when fastened in place is rigid. The design is so compact that the regular capacity of the machine is dimished but slightly. It is stated that the attachment can be removed and the machine restored to its original condition for surface grinding with a large wheel in less than one minute.

The attachment consists of a combination bracket and spindle housing, grinding spindle, driving pulley, and driving belt. The spindle is made of special steel and mounted on self-aligning ball bearings, these bearings permitting the use of high spindle speeds that enable the correct surface speeds for wheels as small as $\frac{3}{4}$ in. in diameter to be secured. The spindle housing is enclosed to exclude dust from the bearings, but the construction is such that should examination be necessary at any time the spindle and bearings can be readily removed. The bracket that holds the attachment in position is of the clamping type and fastens to the grinding machine in place of the regular wheel guard, which is not required while the attachment is being used. The whole device is secured in place with one screw. The driving pulleys, of which two are furnished, are placed in the position regularly occupied by the grinding wheel, and motion is conveyed to the high-speed spindle by means of an endless elastic belt.

It is claimed that the device is particularly valuable in gage and other such work where it is generally necessary to use the side of the grinding wheel on the regular spindle. This attachment obviates the necessity of the frequent dressing of the sides of the wheel and the consequent waste, and also overcomes the scratches that are sometimes left when grinding with the side of the wheel. If particularly desirable, it is possible to reduce the size of the spindle so that even smaller openings than $\frac{3}{8}$ in. can be ground in a satisfactory manner. It is also stated that diamond-charged laps can be used advantageously for lapping out narrow slots and irregular forms. The high speeds available make it possible to use the small laps to much greater efficiency than would otherwise be possible.



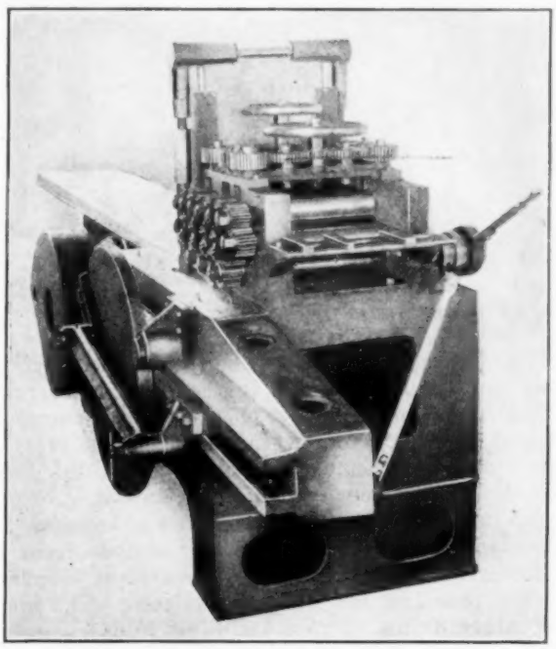
LIBERTY HIGH-SPEED GRINDING ATTACHMENT

Speed of spindle, 15,000 or 20,000 r.p.m. with the grinding-machine spindle running at 3300 r.p.m., the speeds being changed by means of the two large driving pulleys furnished; wheels used, $\frac{3}{8}$ to $1\frac{1}{4}$ in.; equipment includes belts and extra wheels.

Hallden Sheet-Metal Straightening and Cutting-Off Machine

The machine shown in the illustration has been designed to straighten and cut sheet metal into lengths with rapidity and accuracy, and is the product of the Hallden Machine Co., 27 Benedict St., Waterbury, Conn. The feed mechanism consists of a reciprocating rack connected to an eccentric crank disk, the rack meshing with a gear connected to a one-way clutch, the shaft of which is in turn geared directly to the straightening and feed rolls. The crank disk is graduated and by adjusting the eccentric along these graduations any desired length of stroke can be given to the rack. This in turn causes the machine to cut the sheet metal to the length desired. The crank feeding device gives an accelerating motion when starting the feed rolls

and a decelerating motion in stopping them, and this, it is stated, makes it possible to run the machine at a very high speed without the shock when the feed rolls are either set in motion or stopped. The gate shear is connected to the crank-disk shaft by means of two eccentric cams and is so timed that during one half of the revolution of the crankshaft the metal is fed through the shear, while during the other half the cutting-off operation is accomplished. The machine is directly connected to a 5- or 7½-hp. motor, as desired, with a flywheel on the first shaft. A double clutch gives two speeds to the machine, a second clutch being provided for cutting out the feed rolls when squaring off the front end of the metal to be operated upon. It is stated that the whole machine is very ruggedly built

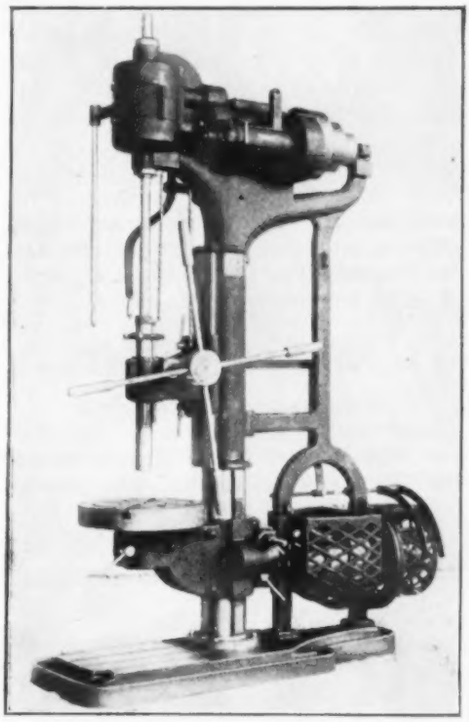


HALLDEN AUTOMATIC SHEET-METAL STRAIGHTENING AND CUTTING-OFF MACHINE

and that small and delicate parts and springs have been eliminated. It is stated that the rapidity with which work can be turned out is very great and that the machine will cut accurately to $\frac{1}{32}$-in. lengths. Two sizes are made, the No. 2 taking metal up to 14 in. wide and $\frac{1}{8}$ in. thick, and cutting any lengths up to 12 ft.; while the No. 3 machine takes metal up to 18 in. wide and $\frac{1}{8}$ in. thick, and will cut any length up to 12 ft.

Weigel 21-In. Drilling Machine.

The drilling machine shown in the illustration is manufactured by the Weigel Machine Tool Co., Peru, Indiana. It is of the 21-in. size and is equipped with back gears, tapping attachment and plain quick return. On this machine the standard friction quick return and power feed has been eliminated and a plain quick return substituted. The quick-return shaft carries four long levers mounted in the form of a pilot wheel giving a powerful hand feed and enabling the operator to produce work much more rapidly where power feed is not required. The machine is also built without the tapping attaching or back gears. When back gears are not included, the machine is equipped with a friction drive for starting and has a brake to stop the machine



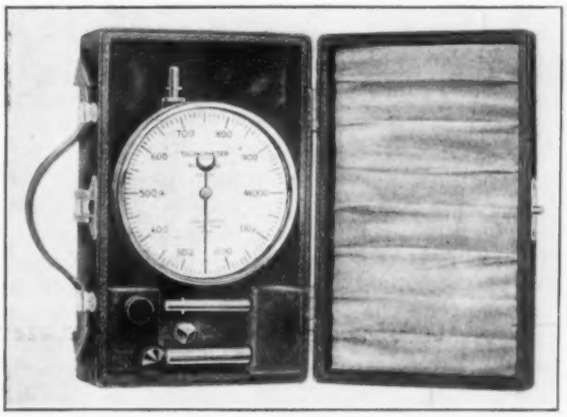
WEIGEL 21-IN. DRILLING MACHINE WITH BACK GEAR TAPPING ATTACHMENT AND PLAIN QUICK RETURN

Extreme height with spindle extended, 9 ft. 10 in.; distance from base to spindle, 46¼ in.; distance from table to spindle, 30¼ in.; drills to center of 21⅝ in. circle; traverse of table on column, 13¼ in.; traverse of head on column, 21 in.; traverse of spindle, 9 in.; diameter of table, 19 in.; diameter of column, 7 in.; diameter of spindle above sleeve, 1⅞ in.; diameter of spindle in sleeve, 1¼ in.; diameter of sleeve, 2⅝ in.; spindle bored, No. 4 Morse taper; ratio of bevel gears, 2.5 to 1; ratio of back gears, 6.44 to 1; speeds with open belt, 400, 200 and 100 r.p.m.; speeds with back gears, 63, 31 and 16 r.p.m.; net weight, 2100 lb.

instantly. The control lever for starting and stopping the machine is located at the front in the same position as the back gear lever shown in the illustration. A similar machine is also made in the 25-in. size.

Jones Type H-2 Hand Tachometer

Jones-Motrola, Inc., 29-33 West 35th St., New York, has recently placed on the market the type H-2 hand tachometer shown in the illustration. This device is useful where it is desired to be able to test the speeds of shafts, engines, etc., directly by the use of a portable instrument. The device is intended to be held in the palm of the hand, but a handle can be supplied at addi-

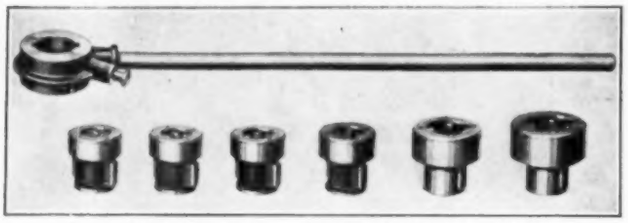


JONES TYPE H-2 HAND TACHOMETER

tional cost if desired. The instrument is supplied with a set of couplings comprising a triangular steel tip, a center punch for the triangular tip, a rubber tip, a rubber funnel cup for pointed shafts, and an extension rod. The body is finished in black japan with nickel-plated trimming, and the case is covered with morocco. Three different types of instruments are provided, No. 1 for indicating revolutions from 100 to 1200 per minute, No. 2 for revolutions from 500 to 2500 per minute, and No. 3 for revolutions from 1000 to 5000 per minute. The size of the dial of all instruments is 4 in. in diameter.

Beaver Jr. No. 3 Pipe-Threading Tool

A compact ratchet pipe-threading device called the "Beaver Junior No. 3" has been added by the Borden Co., Warren, Ohio, to their line of die stocks and square end cutters. It is built on the unit plan as shown and

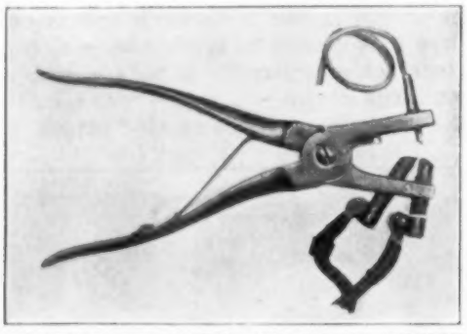


NO. 3 BEAVER JR. PIPE-THREADING TOOL

can be purchased complete or in separate units. The units will cut ¼-in., ⅜-in., ½-in., ¾-in., and 1-in. pipe threads. The complete outfit consists of a ratchet handle with dustproof casing about the ratchet and separate die heads to thread each size of pipe.

Hendrick Electric Soldering Device

The device shown in the illustration is for light soldering work and is being marketed by F. H. Hendrick, 513 Congress Building, Detroit, Mich. The metal to be soldered is heated between two carbon points by the resistance established. Closing the tool brings the solder into contact with the hot metal and does the soldering. The device is intended to be used with an ordinary 6-volt storage battery, but

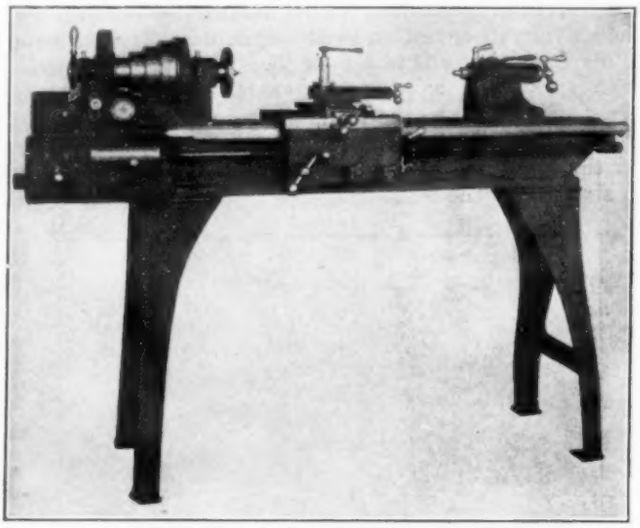


HENDRICK ELECTRIC SOLDERING DEVICE

ordinary lighting voltages can of course be used if stepped down. It is stated that as the heat is applied directly to the point where it is needed and is only used during the time necessary for soldering, the energy consumed is only about one-tenth of that required by other soldering irons of equivalent capacity. It is ready at all times and the workman does not have to wait until the iron becomes hot.

"Star" 11-In. Quick-Change Lathe

The Seneca Falls Manufacturing Co. Inc., Seneca Falls, N. Y., has just brought out the 11-in. lathe illustrated. This lathe has a quick-change gear equipment, consisting of a train of nine gears in the form of a cone mounted on the lead screw, the whole being en-



"STAR" 11-IN. QUICK-CHANGE LATHE

closed in the main gear box and controlled by one tumbler handle. By means of another tumbler carrying a set of compounding gears, 45 different changes of feeds and threads, from 3 to 96 including 11½, are secured. Any desired thread not given on the index plate may be obtained by using the necessary change gears on the feed stud. The web-pattern headstock has a hollow spindle with 1 in. hole and is made from 60-65 point carbon crucible steel. The carriage is gibbed front and rear and has power cross feed. The apron has a safety device so that opposing feeds cannot be engaged at the same time. This lathe may be used with any of the usual line of extra attachments.

Fitting a New Nut Under Difficulties

By J. B. Gray

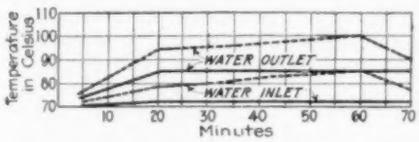
A few days ago the nut on the vertical adjustment screw on our Lucas boring mill was stripped by reason of the head being run down too far. Our job was to replace this nut, and as the foreman did not want to remove the screw and no gage was available, this is the way the job was done.

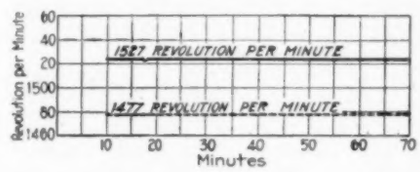
A piece of cast-iron scrap was chucked in the lathe and bored to within ⅛ in. of the outside diameter of the nut. It was then removed, drilled and tapped for a ⅜-in. setscrew near the outer end. The piece was then rechucked and bored to a slip fit for the nut. In the meantime one of the boys had bored and turned the blank which was then placed in the chucked bushing, the ⅜-in. hole scribed off and the blank countersunk enough to securely seat the screw. This of course rendered it possible to remove the nut at any time for trial on the end of the screw which was still in position on the boring mill, and to replace it in the lathe for further cutting without danger of it "running out" or of the thread tool not taking the lead properly. The nut was removed and tried five or six times, before a satisfactory fit was obtained.

LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors

To test both a generator-battery ignition system and the magneto-ignition system a 12-cylinder airplane engine was tested for 1 hr. and 10 min. The comparative results are





shown in the diagrams. The magneto-equipped motor gave 50 more revolutions per minute, using 3.13 gal. less gasoline and 0.75 gal. less oil than the other.

The recommendations of the National Advisory Committee for Aeronautics for legislation, placing the licensing and regulation of aerial navigation in charge of the Department of Commerce, has been submitted to the House of Representatives fully approved by President Wilson. The legislation would give the Department of Commerce authority to issue licenses for civilian operation of aircraft and provides an appropriation of $25,000 for necessary expenses.

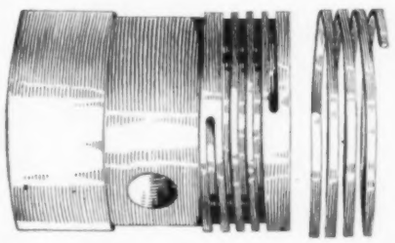
The Standards Committee of the S. A. E. has been considering the uniformity of the present practice for industrial truck-tire sizes. The tire and rim division of the committee recommends that the following truck tire and wheel dimensions be adopted as S. A. E. standard:

—Tire Dimensions— Nominal Diameter, In.	Sectional Widths, In.	— Wheel Dimensions — Wheel Diameter, In.	Width of Felloes, In.
10	3½	6	2½
10	5	6	4½
16	3½	12	2½
16	5	12	4½
20	3½	16	2½
20	5	16	4½
24	3½	20	2½
28	3½	24	2½

Wheel diameters shall be 4 in. less than the nominal tire diameters. The thickness of the finished tire is to be 2 in. for all sizes. The width of the wheel felloe is to be in accordance with the present S. A. E. standard truck-tire practice and the rim diameter tolerances will be plus 0.005 minus zero.

According to an Associated Press report, Harold Wolf has constructed an airplane which is driven by six 300-hp. motors. For performance it is sufficient to use only four motors. The six motors, which drive two four-bladed tractor and two four-bladed pusher propellers, are connected in such a way that it is possible to switch in or out any of the motors without affecting the speed of the propellers. It is further said that the airplane is equipped with a turn indicator to enable the pilot to keep the desired direction while flying on the darkest night or in the thickest fog. The machine has a span of 165 ft. and an overall height of 23 ft.

A new piston ring, as shown in the illustration, called the "Four in One Helix" was placed recently on the market. It is a coil of four complete circles in one continuous piece, giving an equal distribution of expansion over the full length of the ring and taking up the wear in the cylinder without



leaving any gaps. Another advantage of this ring over the usual piston-ring types is that sharp points and weak places that may break off and scar the cylinder are eliminated. Recently a large Holt tractor equipped with this piston ring was operated 24 hours a day for 32 days. When it was overhauled the rings were found to be in perfect order.

More than a score of aircraft types were exhibited at the Aeronautical Exposition held in New York, Mar. 1 to 15. Although the exhibits were for the most part essentially warlike in character, there were indications that the manufacturers are preparing to make strong bids for commercial orders in the very near future. A comparison of this show with the previous one brought out marked contrasts both in the developments which have taken place in motor and construction details and in the purpose back of the respective exhibitions. The first one was an endeavor to stimulate our preparations for war in the air while the present one is an attempt, and apparently a successful one, to interest the public in the peaceful possibilities of both heavier- and lighter-than-air machines. Close inspection of the planes brings out the fact that the use of standardized parts and fittings is growing with a speed that augurs well for the reduction of prices to a point within reach of the pocketbooks of others besides millionaires. Details of construction which indicate the opening of new fields for the machinery manufacturer include the large use of ply woods for which special machines must be developed, all steel wing construction the possibilities of which have hardly been realized, improvements in metal fittings which make them better suited to quantity production operations, and the introduction of balsa wood which has half the strength of spruce although it is extremely light. One manufacturer of large planes is using 3 per cent. chrome nickel steel for his fittings and sockets, and other examples of the use of the finest materials and the best workmanship are numerous. There are several different planes at the show with an official performance of better than 160 m.p.h. and with almost unbelievable rates of climb. In these machines the high development of streamline design and the location of the radiators either in the center section of the upper wing or alongside the fuselage are significant features. Better design of landing gears is evident in many cases. The Army and Navy exhibits were very complete and held the crowds, while the model exhibits of the Curtiss Company's research department and the instruments and scientific apparatus shown by the National Advisory Committee for Aeronautics attracted the technical men. The development of radio-communication, gunnery and gunnery training, and aerial photography were shown by the Army, and a small gage testing apparatus exhibit and a flock of carrier pigeons formed part of the Navy side-show. Foreign makers were represented and also the makers of spherical, kite and dirigible balloons. Engines exhibited ran from the two, three and four cylinder air-cooled models not much larger than motor-cycle motors through a wide range of sizes up to an 850-hp. model with 16 cylinders. Lightness of weight for the power developed and excellent materials and workmanship distinguished the larger ones which had been designed purely for war conditions. The general feeling except among some of the engine makers was one of optimism which bids well for a bright future for the airplane as a rapid conveyance for commercial purposes as well as that of pleasure.

Sparks from the

Polish Engineers Organize To Assist Trade

Will Give All Possible Information to American Business Men as to Polish Markets

Of all the so-called new countries in the peace conference, the most neglected, the least heard of, and the country which suffered most from German and Russian cruelty, is Poland. We all know about devastated Belgium but forget entirely that retreating German armies robbed Poland even of telegraph wires and left behind but 50 locomotives in a country of 21,000,000 inhabitants.

In spite of the cruelty of the three barbaric governments which ruled Poland before the great war, it was a good country to live in and offered good opportunities for the enterprising manufacturer. Its geographical location makes it the unloading center of the east European commerce. It is very rich in mineral resources, having plenty of coal, iron, copper and silver, and an ample supply of skilled labor to draw upon. Poland, before the outbreak of the war, was developing its manufacturing facilities and was supplying eastern Europe with the products of its manufacture.

This country, now free is showing a wonderful spirit of organization contrary to all expectations of her short-sighted enemies. The new government is fairly conservative to insure its stability, but progressive enough to satisfy the radical elements, and is gaining strength every day. She will soon need help to put her industries in shape, to give the farmer his tools, to give the laboring classes work, and as any dealings with her nearest neighbor are out of the question for years to come, it is timely and imperative to create a close commercial intercourse with the U. S. A.

The Society of Polish Engineers and Business Men recently organized with headquarters at the Engineering Societies Building, New York, and having among its members many men favorably known to American manufacturers, is working hand-in-hand with the present Polish government to create and facilitate such intercourse. A specially appointed committee collects such material and data as catalogs, descriptions and models of American products. These will be placed at the disposal of buyers from Poland and will inform the manufacturers in Poland as to prices, possible deliveries, best sources of supply and the like.

The society will gladly give all possible information to American business men as to Polish markets and selling possibilities. It is expected that this young institution will do its share in the great work of reconstruction of Poland and at the same time prove very useful to the business man and manufacturer of the country.

Kansas City Tractor Show

At the Fourth Annual Tractor Show held in Kansas City, Mo., Feb. 24 to Mar. 1, about 70 tractor manufacturers, nearly 40 manufacturers of tractor-tractors shown for the first time and drawn tools and tractor-driven machinery and more than 220 makers of tractor parts and equipment had exhibits in the temporary building erected for this purpose, containing 110,000 sq.ft. The main interest of the show was centered around the many new models of tractors shown for the first time and there were few tractors that did not have at least one new feature or improvement since last year. The show was characterized by the refinements of tractor design such as the inclosing of all running parts, proper lubrication and the installation of bearings.

When Fellers Needs Friends : : : By BRIGGS

Reprinted from New York Tribune

Business Items

The Betts Machine Co., Rochester, N. Y., has recently opened branch offices at 50 Church St., New York, with F. C. Severin in charge and also at 549 Washington Boulevard, Chicago, in charge of A. W. Van Buren.

The Aborn Steel Co. has opened an office and warehouse in Boston, Mass. This branch will be in charge of R. H. Smith as district manager. Mr. Smith was formerly with the Colonial Steel Co. and the Brown Wales Co.

The American Standard Metal Products Co., formerly the American Munition Co. of Bordentown and Paulsboro, N. J., has removed the machine and stock of the Bordentown plant to Paulsboro where it will continue to do business.

The Sullivan Machinery Co., Chicago, Ill., has established a branch office and warehouse at Edificio Oliver, No. 3, Mexico City, Mexico. Joseph F. Bennett for a number of years, sales engineer in Mexico, associated with the El Paso branch of this company, has been placed in charge of the Mexico City office.

The International Oxygen Co., Newark, N. J., has opened offices in the First National Bank Building, Pittsburgh, Penn., in charge of R. A. Cornwall. Philip Wesley, whom Mr. Cornwall succeeds, has been placed at the head of the Chicago sales office in the Railway Exchange Building.

Moltrup Steel Products Co., Beaver Falls, Penn., manufacturers of cold-drawn-steel shafting and screw steel, finished machine keys, finished steel plates and other steel specialties, announces the opening of its eastern branch office, Woolworth Building, New York. The agency is in charge of J. J. Callahan.

The Chicago Pneumatic Tool Co. has moved its Detroit office from 236 Hancock Ave. to 502 Farwell Building, Detroit, Mich.

The W. A. Jones Foundry and Machine Co., Chicago, Ill., manufacturers of power transmission apparatus, special foundry and machine work, and also the Jones spur gear speed reducer, has opened an eastern office at 30 Church St., New York, under the direction of Lemuel C. Bigelow, who for a number of years held a similar position with the Morse Chain Co., Ithaca, New York.

World's Industrial Forge

By E. C. Porter
News Editor

Personals

GRANT J. WOOLSTON, formerly of the Fulton Steel Corporation is now associated with the Aborn Steel Co., 22 Clarke St., New York.

THOMAS PRICE, who has been with the Midvale Steel Co., for over 20 years, is now with the Aborn Steel Co., Inc., at 22 Clarke St., New York.

NELSON B. GATCH was recently made district manager of sales for the Chicago Pneumatic Tool Co., Minn., with offices at 301 Metropolitan Bank Building.

J. K. HAIGH has recently been appointed assistant district manager of sales for the Chicago Pneumatic Tool Co. at the San Francisco office, 175 First St.

E. W. SNYDER, for many years with J. B. Sipe & Co., is now with the Hilo Varnish Corporation, Brooklyn, N. Y. He will make his headquarters in Pittsburgh and serve the trade in western Pennsylvania, eastern Ohio and northern West Virginia.

F. J. HENDERICK, formerly chief engineer of the Davenport Manufacturing Co., Davenport, Iowa, which during the war was engaged in making 240-mm. howitzers and the Blackhawk aeroplane for the Curtiss company, has joined the engineering department of the Hart-Parr Co., Charles City, Iowa.

EDWARD N. HAY, recently discharged from his commission of Captain of Ordnance, U. S. Army, has joined the Robert T. Pollock Co., 68 Devonshire St., Boston, Mass. He comes to this company after a thorough study of the latest manufacturing processes and methods of organization of some of the best known concerns in France, England and Scotland.

CALVERT TOWNLEY, assistant to the president of the Westinghouse Electric and Manufacturing Co., at the annual meeting of the Engineering Council, held Feb. 20, was reappointed chairman of the Water Conservation Committee for one year. He was also made a member of the Reconstruction Committee for the year terminating February, 1920.

CHESTER MOTT has been appointed manager of the Denver, Colo., branch of the Sullivan Machinery Co., Chicago, Ill., succeeding Wallace T. Roberts, recently resigned. Mr. Mott has been associated with this company for several years past in the capacity of sales engineer at its Spokane, Wash., office.

SAMUEL ARONSON, formerly a member of the editorial staff of the *American Machinist*, and for the past two years secretary and sales manager of the Presto Machine Works, Inc., has acquired an interest in the newly organized Presto Phono Parts Corporation, 124 Pearl St., Brooklyn, N. Y., of which he has been elected president. The two corporations have been merged for manufacturing purposes.

1) AFTER YOU HAVE READ ALL ABOUT THE BOLSHEVIKI FIZZLE AND HAVE SOLILOQUIZED THUSLY—
IT SURE IS ONE BIG OBJECT LESSON OF DEFEAT THRU LACK OF TEAMWORK—
2) — AND THEN YOU GET INSTRUCTIONS FRM THE HOME OFFICE RELATIVE TO YOUR PART IN A SPECIAL CAMPAIGN
3) AND YOU DISAGREE WITH THE PLAN — IN FACT IT IS NOT AT ALL IN ACCORD WITH YOUR IDEAS
4) — AND YOU GO UP IN THE AIR AND VOTE THAT AS FAR AS YOUR COOPERATION IS CONCERNED — THEY CAN COUNT YOU OUT
5) — AND IF A BOLSHEVIKI COULD HAVE READ OF YOUR THOUGHTS HE WOULD HAVE SAID — "WELCOME LITTLE BROTHER TO OUR SACRED INNER CIRCLESKY"
6) AND DEVELOPEMENTS PROVE THAT YOU WERE WRONG — AND YOUVE BEEN SHY ON TEAMWORK
GOSH AINT IT DISCOURAGIN' ! — ! — !

Reprinted from Graphite

The British Machine-Tool Situation

Preparations Being Made for Exhibitions Next Year—Good Prices Obtained for Used Machine Tools

The Machine Tool Association has been postponing its proposed exhibition from time to time during the war, and, while it has not as yet settled on a definite date, there seems to be indications that an attempt will be made to hold it this year. Whether the place of exhibition will be in London or not does not seem to have been settled. The municipal authorities of Glasgow, however, have apparently decided to hold an engineering exhibition during the spring of 1920, and this will include machine tools appropriate to the industries of that locality.

The postponement, if not abandonment, of several promising engineering plans, has increased the amount of unemployment in the vicinity of Glasgow. It is quite probable, however, that as soon as the present uncertainty can be relieved to some extent, considerable improvement will be made in many of the plants of various kinds in this neighborhood.

GLASGOW UNIVERSITY GETS $15,000

The Glasgow University has received about $15,000 for the founding of a lectureship on engineering production, which is to embrace the study of machine tools, the art of cutting metals, and the method of production. This is the gift of Mrs. Todd Loudon, and a similar sum is to come from the estate of her late husband. Whether this will include the installation of actual machine tools or not is not stated.

The shipbuilding trade of the Clyde is reported to be busy and a new concern known as the Greenock Dockyard Co., Ltd., with a capital of about $500,000, has been formed to build and repair ships at Greenock and Grangemouth. W. Beardmore & Co., Ltd., is beginning to manufacture locomotives at Clydebank. Other locomotive builders and all the makers of motor vehicles in this vicinity are full of orders, and some interesting new models are soon to appear.

Machine-tool builders are also in full operation, including machines for shipyards, and also jigs, fixtures, gages, and special tools. Even standard lathes and gear-cutting machinery are in good demand, as well as makers of motor-truck transmission.

The Manchester district is to a certain extent marking time, although, after allowing for canceled and modified orders on both government and private work, many orders for machine tools still remain on the books. There

is also a fair inquiry for machine tools from concerns which are readjusting themselves from war-time to peace products. There is a noticeable interest in appliances for handling material in and around the shops.

Smith and Coventry, Ltd., are building high-speed planing and powerful vertical milling machines, as well as lathes for relieving milling cutters. J. Spencer & Co., Ltd., Hollinwood, is busy with vertical drilling machines, especially for army transport repairs. They are also building other machines for this work. Dronsfield Bros., Ltd., are again building textile machinery and accessories and report an insistent demand from textile mills in both France and Belgium.

Conditions Around Birmingham

Conditions in and around Birmingham are gradually improving. One of the drawbacks is the difficulty of shop managers in accurately estimating the cost of their product as well as forecasting delivery dates which can be met. This is, of course, due to nearly everything being more or less indefinite, and the fact that the prospective buyer is not disposed to accept unlimited risks in either case. A rise in the price of iron and steel is looked for. In the iron and steel field, at least, it is reported that in spite of the rapid release of men from the army, the labor supply continues inadequate to balance the reduction of working hours. This does not seem to agree with the experience of machine builders, and may be partially due to the fact that the iron and steel industry, as carried on, is not an attractive occupation, and is in most cases only taken up when the man fails to secure satisfactory employment elsewhere.

Much repair work is being done in the readjusting of manufacturing plants to their old-time or at least to peace products of some kind. This is making an active demand for some lines of machine tools. Some of this demand is quite sure to be satisfied by the second-hand machinery which is being released by the demobilization of the national factories, and, while some of the special machines are of little value, there are many which can be used on regular products.

Auction Prices of Machinery

It is stated by the auctioneers of the National Shell Factory at Washwood Heath, that some of the machinery there sold for more than its cost, this being notably true in the case of electric motors and time-recording machines. Radial drilling machines sold for $1800, a 150-ton hydraulic press brought $850, and a double-sided power press $2500. In the toolroom equipment a 14-in. lathe sold for $800, an 18-in. lathe for $1500, and a 25-in. lathe for about the same price. A Cincinnati milling machine brought $1500, an unnamed vertical milling machine, $1100, and a 14-in. shaping machine, $850, while turret lathes of all kinds were in great demand.

London, Mar. 17, 1919.

British National Shell Factories Being Sold

Advertisements are appearing in the British daily papers with regard to the disposal of British shell factories and their equipment. One of these refers to the National Shell Factory at Grimsby, in which the plant and machinery are being sold at auction by direction of the Disposal Board. The equipment includes 80 lathes, six 8-in. bar cutters, 5 thread milling machines, and various items of electric motors, shafting, pulleys, hangers, chucks, gages, grinding wheels and the like.

The National Ordnance Factory at Armley-Road, Leeds, is also advertised for sale. The equipment comprises some 189 single-purpose lathes, 26 boring machines, 7 horizontal milling machines, 16 drilling machines, 30 grinding machines of various types, 9 turret lathes, 12 cutting-off machines, and other equipment in proportion.

The National Shell Factory at Barnsley is advertised together with 76 turret and single-purpose lathes, varying from 12 to 25 in. swing, 7 radial and sensitive drilling machines, 5 thread milling machines, 7 bar-cutting machines, 2 milling machines, 6 grinders, 1 slotting machine. At this plant one item of stores includes 3 tons and 17 cwt. of high-speed steel.

Export Opportunities

EXPORT OPPORTUNITIES

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A man in France desires to secure an agency for the sale of machine tools, tools, hardware, belts, oils, greases. Correspondence should be in French. Reference. No. 28,729.

A man in England desires to purchase and also to secure the exclusive agency for the sale of bright steel pins, milled both ends, in quantities of 2 cwt., ⅞ in. x 14 gage; 4 cwt., ¾ in. x 14 gage; and 2 cwt., ⅝ in. x 17 gage. References. No. 28,725.

An engineer in France desires to secure a general agency for the sale of pneumatic hammers and woodworking machines. Correspondence should be in French. Reference. No. 28,689.

A commercial agent in France desires to secure an agency for the sale of machines, machine tools, steel, and motors. Correspondence should be in French. Reference. No. 28,709.

A man in France desires to secure an agency for the sale of motor cars, electrical appliances and supplies, hardware, tools, machinery for contractor's plant, carriage, hardware, etc. Correspondence may be in English. References. No. 28,670.

A company in Norway desires to secure an agency for the sale of wrought iron, T-irons, channel iron, rails, plates for shipbuilding, etc., and iron and steel. Payment against documents in New York. Reference. No. 28,666.

A firm in Norway desires to secure an agency for the sale of electrical materials, such as cable, wire and accessories, and insulating materials; woodworking, metal, and ironworking machinery and tools; concrete-making machinery (molds, mixers, etc.); belting, packings, hose, etc.; raw materials, as carborundum, corundum, emery; oils, greases, wax, paraffin, varnishes; bookbindery machines; and engineering and building equipment. Correspondence may be in English. References. No. 28656.

A firm in Italy desires to represent manufacturers of metal-working machines, woodworking machines, hand tools, motors and implements for motorboats and aircrafts, and other industrial supplies. No. 28628.

Obituary

Clarence W. Hobbs, former president of the Hobbs Manufacturing Co., died of heart disease at his home in Worcester, Mass., Feb. 20, 1919, at the age of 67 years.

F. A. Falkenbach, sales manager of the Modern Tool Die and Machine Co., Columbus, Ohio, died on Mar. 14, 1919, at Youngstown, Ohio.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, April 15, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, New York.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

New Jersey Foundrymen's Association. Regular meeting, Apr. 2. An illustrated lecture on sand-blast equipment, to be given by H. D. Gates of the Pangborn Corporation, Hagerstown, Md.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, Apr. 28, 29 and 30.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.